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Automatic Gear Cutter.

In our issue of April 5th we illustrated an improved automatic spur gear cutter, designed especially with reference to such work as is done in cutting gears for electric motors, and therefore capable of cutting spur gears only. The present illustration is of a machine of the same type and retaining the same general characteristics, but arranged to cut bevel as well as spur gears.

In this machine, as in the former one, the cutter is placed in the center of the saddle, is fed forward by a screw which is directly in line with it, and all extra belts, tighteners, etc., are dispensed with.

It is built by Gould & Eberhardt, Newark, N. J.

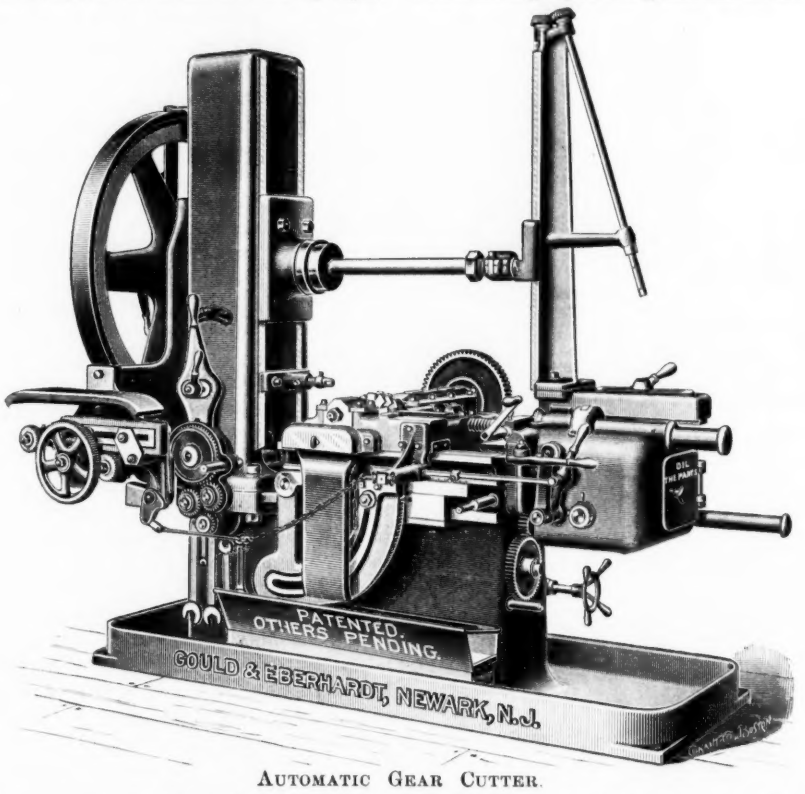
A New Arrangement of Taper Attachment.

In our Chicago correspondence (issue of August 3, 1893), we referred to a new arrangement of the Slate taper attachment for lathes, as exhibited by Flather & Co., of Nashua, N. H. At that time we were able to give only a small sketch illustrative of the main idea, but now are enabled to give engravings showing the construction fully.

The engraving, Fig. 4, shows the back of a 16-inch "Flather" lathe with this improved taper attachment applied to it, and the details of construction are plainly shown by the smaller engravings.

In this lathe the cross-feed screw is not journaled and collared at the front of the carriage in the usual way, but slides freely within a sleeve shown in section at Fig. 1, the crank handle being keyed to the reduced end of this sleeve instead of directly to the screw, which latter is turned by a feather fixed in the sleeve and engaging with a spline which extends for a short distance from that end of the screw.

Teeth cut in the enlarged portion of this sleeve, as shown, make of it a pinion also by which the screw is driven when the automatic cross-feed is in use.



AUTOMATIC GEAR CUTTER.

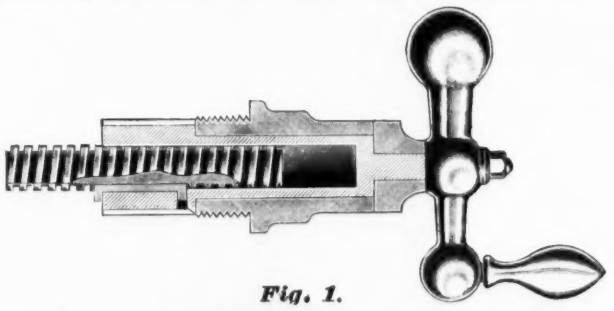


Fig. 1.

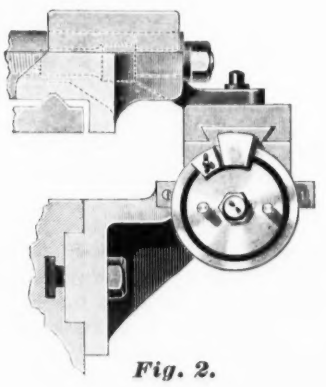


Fig. 2.

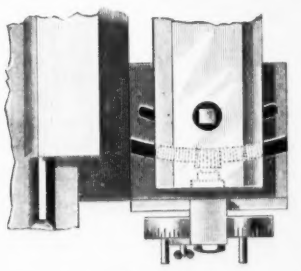


Fig. 3.

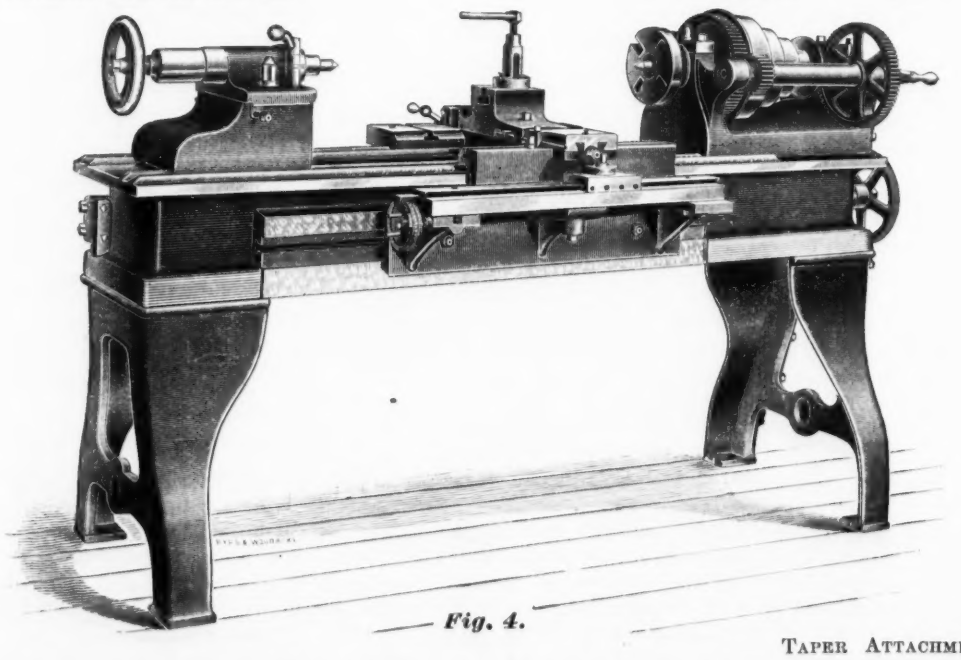


Fig. 4.

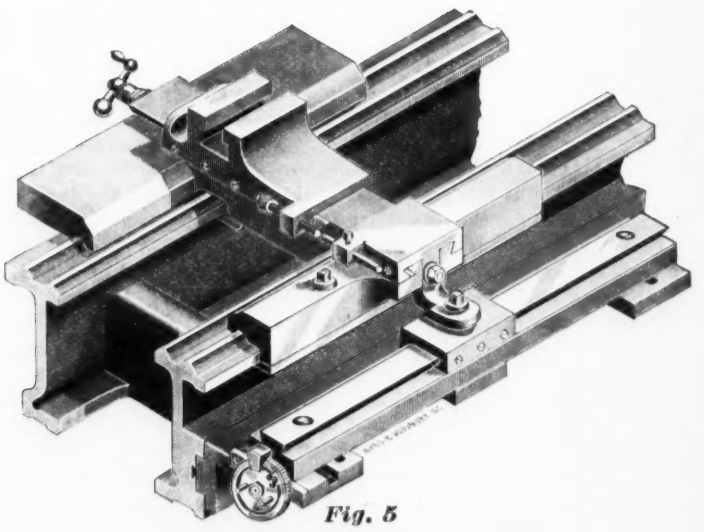


Fig. 5

TAPER ATTACHMENT.

The screw passes through the nut in the usual manner, and is journaled at the back end in a sliding block shown enlarged at Fig. 5. This block fits over the dovetailed cross-slide and slides freely upon it, except when clamped, which can be done by tightening a screw. On the under side of the sliding block is a lug which slides through a short opening or slot formed in the extension of the carriage, and in this lug the cross-feed screw is held by the collar inside and nut and washer shown outside, below which the lug is further extended at right angles and is adapted to be attached to the block sliding upon the guide-bar as shown. A side view of this is shown at Fig. 2.

It will thus be seen that the sliding block, cross-feed screw and tool block will be moved out or in by the guide-bar to produce tapers, and that the tool can at the same time be moved by the crank handle in the usual manner for adjustment of cut, etc., the adjustable stop and stop screw shown either taking up all lost motion when necessary, or gauging the depth of cut, as in screw cutting. With the sliding block disconnected from the taper and clamped to the cross-slide the lathe turns straight, and all this is accomplished by simple, direct and convenient mechanism.

The guide-bar is placed upon sliding brackets, as usual, and the bolts by which it is clamped to these when set have their heads sunk into the top of the bar, as shown at Fig. 5, and can be reached with a wrench from the front of the lathe. The bar is adjusted by means of a graduated disk (Figs. 2 and 3), by which a bevel pinion, shown in dotted lines at Fig. 3, is made to swing the bar. An adjustable graduated stop in the face of the disk further adds to the facility of setting the bar.

All parts of the taper attachment are provided with means of adjustment to take up wear.

A correspondent writes us: Can you or some of the readers of the AMERICAN MACHINIST tell me through the columns of your paper how to make brass ball valves from one to ten inches in diameter, all balls above two inches to be cast hollow, core hole to be plugged and turned to as near a balance as possible?

The subject referred to by our correspondent opens up a wide field, in relation to which we shall hope that some of our correspondents may be able to give him help. The best methods to be practiced in all such cases are generally come at through experience and study.

Compound Radiator Valve.

We illustrate herewith a new valve for radiators, which is designed to do away with the annoyances and danger of flooded floors, which often result from the usual plan of fitting a radiator with two valves—one on the steam pipe, the other on the return pipe, besides an air valve or cock, all of which require looking after.

The valve here shown is the only valve of any kind to be used about a radiator by this system, and consequently there is but one thing to be looked after, and that simply to turn the steam on or off in the usual way.

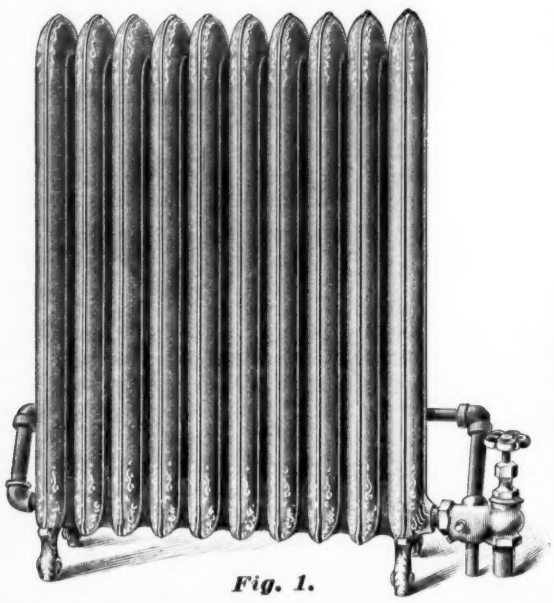


Fig. 1.

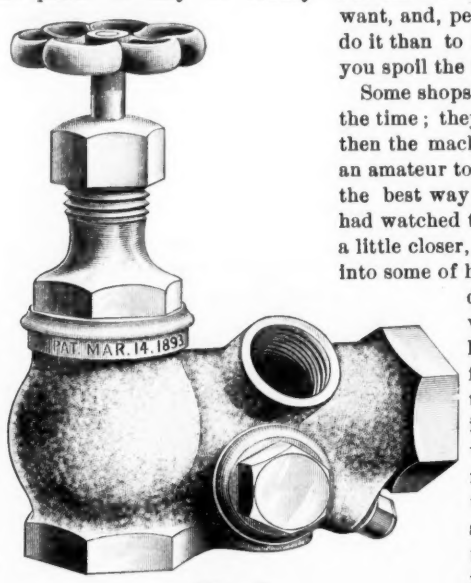


Fig. 2.

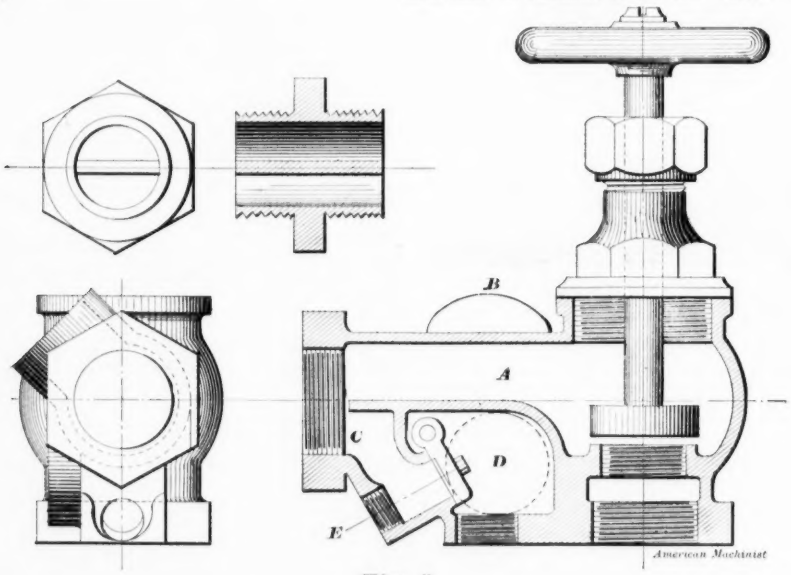


Fig. 3.

Compound Radiator Valve.

Among the objects sought for by the inventor of this valve, is a more positive and complete circulation of steam, as well as to avoid the necessity of an air cock on each radiator.

By referring to the engraving, Fig. 1, it will be seen that there are two steam or supply pipes which put steam into each end of the radiator; by means of which the entire radiating surface is at once brought into operation, and the possibility of being "air bound" (so common to some radiators) is avoided. It is often found impossible to start the air out of a radiator in admitting steam on a cold morning, and it is sometimes hours before the entire radiating surface can be brought into action. How this system operates to avoid this difficulty will be readily understood from an inspection of the valve as shown in Figs. 2 and 3. These cuts show an angle valve with the usual wheel stem and stuffing-box. The passage *A* leading from the valve is, however, divided horizontally into two parts, so that while this valve is screwed into one end of a radiator and supplies steam to it direct, a pipe is also attached to a second outlet *B*, through which steam is introduced into the opposite end as shown in Fig. 1. This pipe passes either behind the radiator when it stands near a wall, or through between the coils when the radiator stands out in the room. Steam being turned on, it flows into the ends of the radiator and quickly heats up each of the coils, and the water of condensation flows out at the passage *C* and through the return pipe to the receiver or boiler. The check valve *D* absolutely prevents any reversal of the circulation, and therefore a positive, continuous circulation in one direction is maintained. This check valve is so attached that it may readily be removed, ground to its seat, or a new one substituted as required through the usual wear of such parts. It may be readily inspected by removing the plug at *E*. These compound valves can be attached to all styles of radiators now in use and with the simple addition of the second pipe to opposite end of radiator from the valve. The return pipe may be easily connected under the radiator without changing holes in ceilings or floors.

It will be seen that each radiator is controlled by one valve only, so that any person can close this valve and shut off the steam without the necessity of considering how many other valves must be closed to prevent flooding the room. The water which remains in the radiator will take care of itself and will, by gravity, discharge through the check valve *D*, therefore there is no danger of freezing up in a cold room, as is the case where there are two valves on each radiator and both of them closed, thereby imprisoning the water. In fact, as will be seen, the necessary manipulation in order to manage the radiator is reduced to its simplest possible element. The valve is the invention of James H. Hutchinson, 117 West One Hundred and Fifteenth street, New York.

Tool Dressing.

By B. F. Spalding.

To dress a tool is to give it its proper shape, to put it in order. It includes the original forging, and the subsequent repairing of tools at the forge.

Tool dressers are generally very accommodating and good-natured, but it is not pleasant to any one of them to have his fire disturbed by any person who takes a notion to stick a tool into it. If you only want to draw the temper out of the tool, don't do it in such a way as to draw the temper out of the tool dresser also. The fire is run for the convenience of the shop, of course, but as long as there is a man specially detailed to run it, and he has the responsibility of the work—no disclaimer can relieve him of this—let him run it to suit his own notions. Tell him what you want, and, perhaps, he had rather let you do it than to bother with it himself, but if you spoil the tool, who will excuse him?

Some shops do not keep a tool dresser all the time; they have their dull seasons, and then the machinist has to turn himself into an amateur tool dresser, and make his tools the best way he can. Then he wishes he had watched the motions of the blacksmith a little closer, and asked him for an insight into some of his methods. That accommodating person would be quite willing to exhibit and explain his methods, if he had time, for he realizes that the more there is known about his business, the better its difficulties will be appreciated, and the more important it will appear to be to employ a man who is skilled in his craft. While a machinist, with good mechanical ideas, is learning to make as good a tool as a blacksmith can make, he is also learning that amateur work is too expensive to be carried on for profit.

It may help some who have to make tools to read a description of some approved methods of forging the kinds in common use for turning and planing. There may be better ways than these I describe, but these are practical. They are old-fashioned, tools have been made by them from the beginning, and are still. My father learned them in Lowell when engine turning superseded shoulder tools, and I learned them when I was an apprentice. I have nothing against patent tool holders; they are good and economical; so are drop-forged tools; but a well-made hand-forged turning tool, solid with the shank, is a friend you can stake your faith upon.

In dressing turning tools it is a matter of primary importance to use such means to handle them as will hold them firmly and securely, so they may be placed in their proper positions on the anvil, and controlled to remain there, without danger of flying about when they are struck. The best way to hold them is with tongs, grooved to seize them edgewise. The jaws of the tongs should be stout, and twice as long as the tool-stock is wide. The groove should not run the whole length of the jaws; when the tongs are new, the groove may be as long as one and a half times the width of the tool-stock, and it will wear out longer by usage.

Diamond points are sometimes made for planer tools, especially with the whole of the diamond point standing above the body of the tool, and sometimes quite commonly for turning tools, with the point starting about half way down. The first is shown at Fig. 1, and the second at Fig. 2. Both of these figures show too much pitch for planer tools; they stand at an angle of about 130 degrees with the shank; planer tools, generally, need no more than 95 degrees pitch. The position of the point of Fig. 2 is shown in its relation to an inch circle, as set a quarter of an inch above the center. In Fig. 1 a line is drawn at right angles to the tool shank to represent the planer platen, and a line at 95 degrees represents the clearance of a tool, standing at that angle.

Before heating the tool-stock, examine it to see that it is square; if it is diamonding, either square it up, or make the tool on the right end to have the side rake come the right way. If you make a right-hand tool on a piece of steel that pitches to the right, you will have to give it extra pitch to the left, to get sufficient side rake. Very few tools rest perfectly flat on the bottom in the tool-post; they ought to, but they don't, and, perhaps, not one man out of a hundred ever had a tool dodge on account of this irregularity; but a tool will not cut unless it is "backed off" or "set off" enough to let the edge enter the work.

The processes of making the two forms of diamond points are similar. To make the first, the stock may be dubbed down bluntly on the point, or it may be laid over the corner of the anvil, without any preliminaries, as at Fig. 3. It is then struck at *A*, and the stock bent down to about the shape shown by the first dotted line. The striking on *A*, to bend this short end down, naturally narrows it up, something as shown in the sketch, and it spreads the other way at the same time. After striking a few blows to bend it, it should be laid flat on the anvil, and reduced to its regular thickness. Don't let it get too much out of shape at any time, but true it up as you go along, and keep it in some regular shape so it will not look as though it had been bungled at, and knocked into confusion. Work diamond points—and all other tools which have to be dressed repeatedly—over a corner of the anvil as rounding as $\frac{3}{8}$ inch round iron; circle, $\frac{3}{16}$ inch radius. This helps to keep out cold shuts. When any sharp corners are left in the throat the tool is weakened by them in the first dressing, and cold shuts are sure to start from them in the second, unless the old point is entirely cut off.

If you are to make a necked tool, like Fig. 2, strike it directly over the corner of the anvil, so as to sink the corner into the stock the depth you desire to go; but if you intend to make Fig. 1, this must be carefully avoided, as you are not to decrease the size of the stock at the root of the point; the blows should, therefore, be struck beyond the corner, and as soon as the stock is bent enough to catch a hold, the direction of the blows must be changed so as to bear against the hold, getting it into the shape

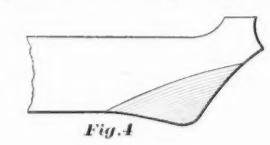


Fig. 4

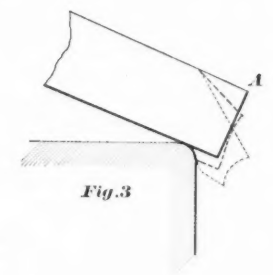


Fig. 3

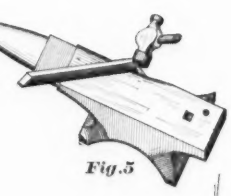


Fig. 5

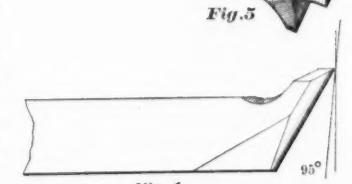


Fig. 1

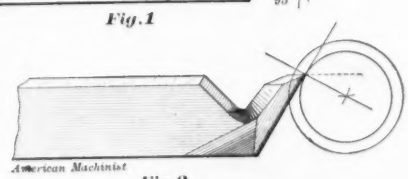


Fig. 2

Tool Dressing.

of the second dotted line of Fig. 3. When the tool has been got into this shape it pitches too much, and has to be got up straighter. It must be laid on the anvil sidewise, in such a position that the heel can be thinned by striking it an oblique blow with the hammer, at an angle corresponding to the position in which the tool lays on the anvil, so that the heel may be thinned by the hammer and anvil alike. This thinning will give it a side view like

Fig. 4. Now, by driving down the stock edgewise to the width of the shank, and keeping the heel thinned, the angle of the rake may be changed to any pitch desired.

The tool is now in good shape to make either a square or round nose, or a diamond point. Up to this stage it should have been kept quite full at the roots. The corners of the present shape are now to be hammered in, and a new square formed, with the sides in the right places to give shape to a diamond point. It may be remarked here that care must be taken to avoid giving the tool a diamond shape in a straight cross-section, but it should be kept as nearly square as possible; that is the best shape to have a piece of steel in to refine it by hammering; it will be diamond-shaped on the face when it is cut off obliquely.

Some tool dressers do not make any effort to give a good form to the heel; they hold the end of the tool over the far corner of the anvil, let the striker hit it a couple of blows to bend it, and then take it over the near corner and work off the point, and let the heel go in slunk shape. A better looking job can be made, with but little more trouble, which will leave the heel standing up flush, and whenever it becomes necessary to put the tool to all the work it can stand, as when it is drawn back into the tool-post to get all the stiffness possible, it will have a good support on the heel as it rests on the tool block.

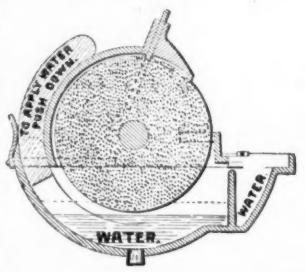
As the front flats, or sides, of the square extend to the heel, while the back flats, or sides, of the square only go down to the body, the back sides will receive a proportionally larger share of the effects of the blows which are struck to change the shape. It is for this reason that the tool at this stage should be stout at the roots, because the resistance has to be found just there, and not higher up, which is to be battered against to shape the front end of the heel. The shaping of the front end of the heel, to the V shape, as the diamond point is being started, is best done over the far corner of the anvil by holding the tool obliquely to the face of the anvil, and shifting it to positions right and left, oblique to the front side of the anvil, as the blows are struck to give it shape, as is shown in Fig. 5.

A little practice will enable the workman to master this difficulty of making the steel stand up to be hammered, when the backing does not directly oppose the full surface of the hammer stroke; it is a desirable accomplishment frequently called into play. In this case a few well-directed blows give the needed shape.

When the heel has been blocked out into promising shape, work on the point may be commenced on the near side of the anvil. This necessitates the workman's getting down low enough to throw the left hand, which grasps the tongs, considerably lower than the anvil, so as to bring the back side of the point in contact with the face of the anvil, while the right hand uses the hammer on the front sides of the point. The workman is liable to spread himself to get this position, and it may be some time before it ceases to be inconvenient. A spread eagle, walking on the ground, is the most awkward thing imaginable, but sailing the sky it is an awe inspiring spectacle. I have seen a workman making a spread eagle of himself, fixing diamond points, who was, also, an awe inspiring spectacle. If it had only been hinted to him that he could bend his knees—squat a little—he could have pulled himself together compactly, and got at his work handily.

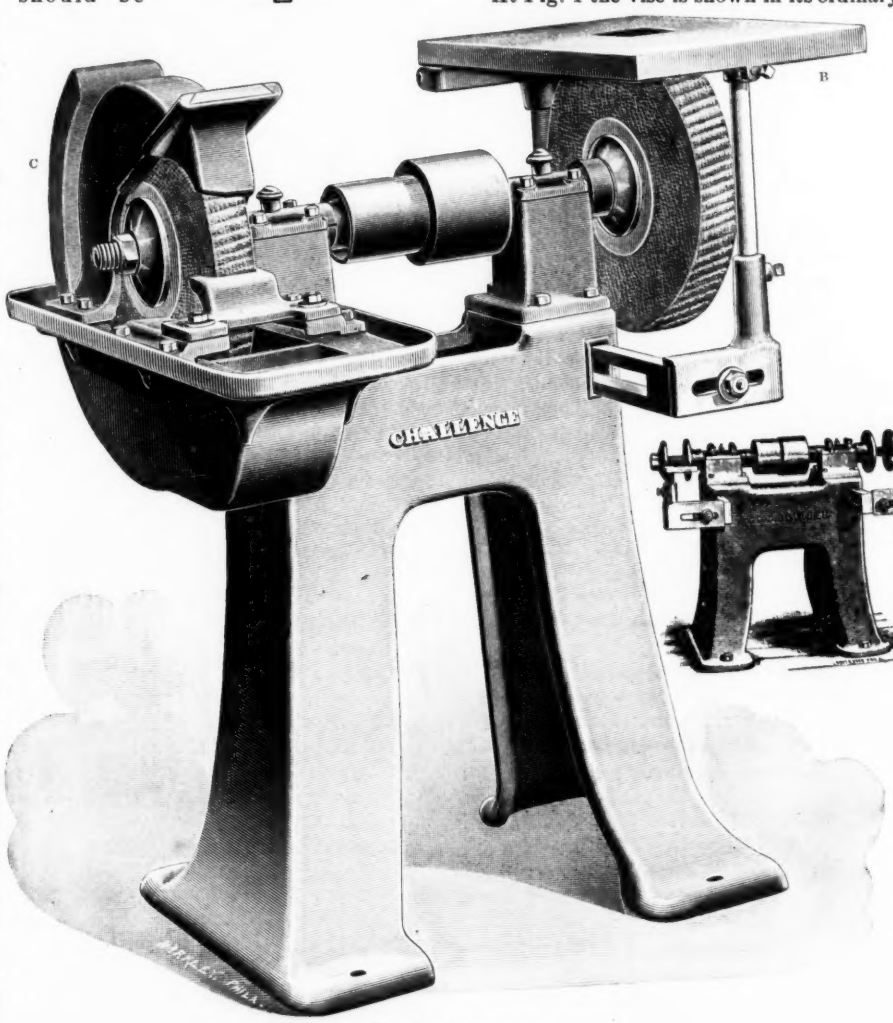
After drawing the point out square, it has to be cut off, and upon the way in which this operation is performed depends the amount of grinding which has to be done. Many a young tool dresser has heard the complaint that he left too much work to be done at the grindstone. If a helper is at hand, the point may be cut with a thin-edged chisel. If the tool is not hot enough to cut off at the forging heat, set the tool with the front side on the anvil, and mark it on the back side with the cold chisel where the cut is to be made, then heat it, not too hot, bring it out, and set it in the same position on a plate of soft iron on the anvil. The cold-chisel mark will guide the hot chisel, so you can get at it at once, without fumbling about and wasting the best of the heat. The chisel must be held as sloping as the bevel of the cut is to be. Look out for the pieces! Don't let them fly! Many eyes have been put out by them. The last blow should be light, and if the cutting plate is soft, the pieces will not be so apt to fly viciously.

In the absence of a helper, an anvil cutter, or "hardy," is as good a tool as need be for cutting off the points. It should be as much as 3 inches high in order to get a good slope to the cut, and the hammer should be used in such a manner as not to pull the stock away from the very point, or it will draw away and be narrower there, and make more grinding necessary.



Instead of cutting it with a chisel, the bevel of the cut may be hammered down. To do this, set the cutting face of the tool so that nearly the whole length of the face required will rest on the anvil, and the surplus reach over the sharp front corner, strike a smart blow to carry the surplus down, and this will make a hold to hammer against until it cuts off. By hammering against it, and edging up the point as it spreads, an angle as blunt as 45 degrees may be easily hammered, and the steel at the point be very well refined.

Attention to the minute directions here given, and some practice, will enable the learner to make a good diamond point. He should not rest satisfied with his proficiency until he can take a piece of $1\frac{1}{4}''\times\frac{5}{8}''$, with a helper, or $1''\times\frac{1}{2}''$ alone, and forge, cut off, and harden a tool at one heat. In jobbing shops in Boston, the common price used to be, for $1''\times\frac{1}{2}''$ and less, 10 cents; and for $1\frac{1}{2}''\times\frac{5}{8}''$, 25 cents for each new tool, besides the cost of stock, which the customers generally preferred to furnish themselves. A fire was expected to charge up a dollar an hour on an average for the proprietors. They would have become rich if they had realized all their expectations.



Emery Grinder.

Improved Vise and Heel Clamp.

In our issue of November 19, 1891, we illustrated an improved bench vise for wood-workers, patternmakers, etc., which was universal in the sense that it could be placed and made to hold work in almost any conceivable position. We now illustrate a vise which is intended for ordinary wood-work.

At Fig. 1 the vise is shown in its ordinary position. The jaws are 12 inches long and 6 inches wide, giving a good clamping surface, and work can be held either side of the screw with equal facility.

This vise is so arranged that it can be swiveled upon a pivot near the top of the bench, and can thus be placed and clamped at any desired angle, such as shown at Fig. 2, for instance, where a board which is to be beveled upon the edge is held at such an angle that the planes and other tools to be used upon it can be used easily and conveniently.

The arrangement for thus placing the vise at any angle is simple in construction and substantial; there being a notched bar extending under the bench and pivoted to the vise which, in connection with a conveniently operated and automatic locking arrangement fixes it at any desired position.

At Fig. 3 the vise is shown turned still further, until in fact its screw is vertical. In this position the lower jaw of the vise is flush with bench and the work is held upon it. This, it will readily be seen, is a great advantage for many kinds of work.

In all these engravings it will be noticed there is a heel clamp, the object of which is to hold work endwise either in connection with the vise or with the bench stop.

In attaching this clamp, a rack is let into the under side of the bench plank near the edge, and the clamp has upon it a pawl which engages with this rack. The advantage of the clamp over the usual tail-screw is, that it moves up to the work in any position, leaving the bench entirely unobstructed at every other point, and it can readily be removed entirely by simply slipping it off the end of the bench. This clamp also does away with all necessity for cutting holes in the upper surface of the bench, the objections to which are so well understood. In operating the clamp, it is simply pushed along the bench until it comes into contact with the work, when, by depressing a small lever attached to it, it is forced against the work, holding it firmly.

The vise and clamp are manufactured by J. F. Emmert & Son, Waynesboro, Pa.

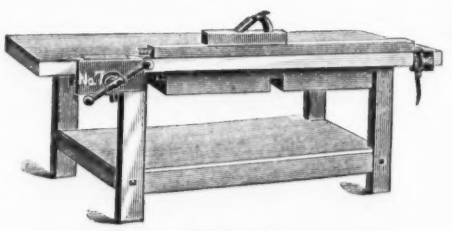


Fig. 1.

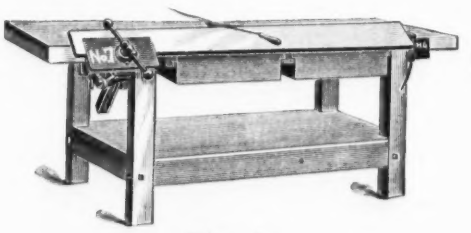


Fig. 2.

Improved Vise and Heel Clamp.

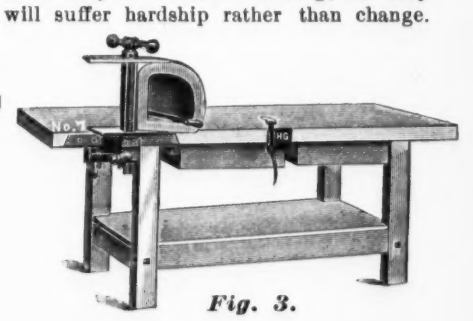


Fig. 3.

Emery Grinder.

This machine is made in seven sizes for wheels from 10 inches to 30 inches diameter, and is so arranged that any one or any two of the different styles of rests shown can be attached to it by simply bolting them on.

The plain rests are shown on the smaller machine, and these can be adjusted in any direction.

At the right of the larger engraving is a surface-grinding rest, which is adjustable vertically, and the work is ground by simply passing it over the opening in the plate, which, for many kinds of surface grinding, is found to be a very efficient and satisfactory method.

At the left of this machine is shown a wet grinding arrangement, in which, as shown by the sectional view, the water is applied to the wheel by pushing down the piece at the back into the water, thus raising its level to touch the wheel.

The reservoir is cleaned by removing a plug at the bottom.

Of course, it will be understood that two surface or two wet grinding arrangements can be used on the same machine if desired, and the wheels may vary in grade, and be used by two workmen simultaneously.

The machines are built by the Appleton Mfg. Co., Thirtieth and Thompson streets, Philadelphia, Pa.

The Free Emigrants Labor Bureau, of New York, is in the position of being unable to supply the demand for laborers, and all this time there is a surplus of laborers in the country. As we have before stated, men do not, in these times, take kindly to occupations just a little different from those they have been following, and they will suffer hardship rather than change. It comes, no doubt, from the economic practice of the day that provides that one man shall fill the pipe and another smoke it.

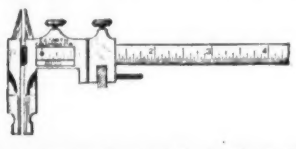
"The laziest man I ever knew," remarked the foreman to the engineer, "was Smykins; the sight of work to be done seemed positively to hurt his feelings."

"I suppose he came to some bad end."

"No. His work worried him so that he invented a machine to do it for him and got rich."—*American Industries.*

Improved Vernier Caliper.

We illustrate by the accompanying engraving a new form of vernier caliper which has two points placed opposite the jaws as shown, the inside surfaces of these pointed projections being straight and parallel, so that when the caliper is set at 0 these surfaces are together, and any other



setting corresponds exactly to their distance apart. On account of this form the point can be sharpened as often as necessary without in the least changing their relative positions so long as the inner parallel surfaces are not touched.

It will be seen that this affords a ready means of laying off distances with all the exactness obtainable by vernier graduations, and the fact that these distances are laid off direct by the vernier caliper itself, of course, contributes to the certainty of the operation.

This form of caliper is made by E. G. Smith, Columbia, Pa.

Conforming Rotary Motion to Reciprocating Motion.

By Frank DeW. Randolph.

In writing this article it is not my intention to develop any new idea, but merely to acquaint some readers of the American Machinist with a very simple, and yet correct way of conforming reciprocating motion to rotary motion. The method here described would not, of course, be applicable to all conceivable cases; but, in cases where the whole stroke is not required to conform to the rotary motion of the crank-pin, we have an accurate formula. I tried several ways of accomplishing this result, but finally decided to use irregular gears; and the method of constructing these gears is the substance of the present article.

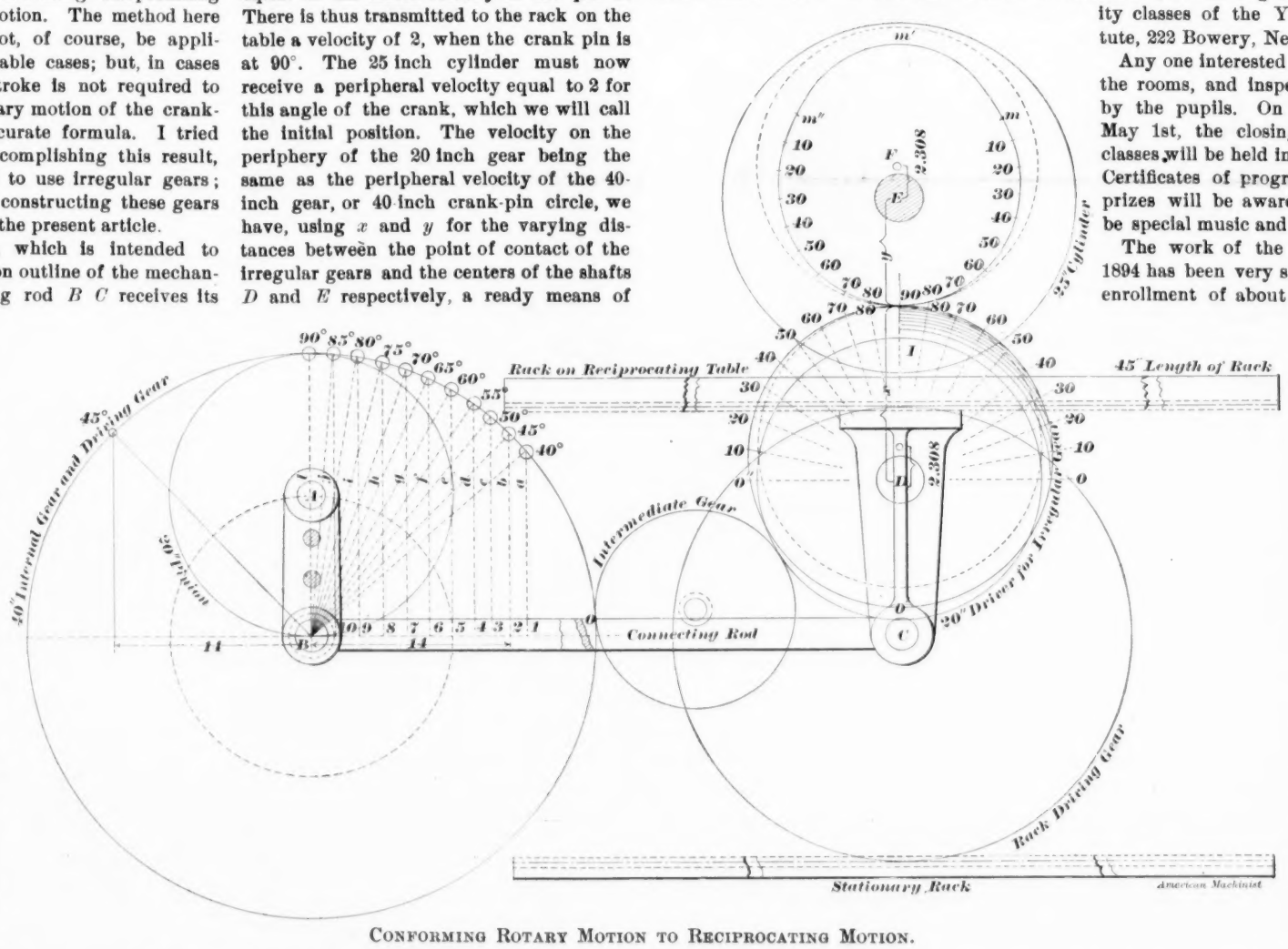
In the drawing, which is intended to show only a skeleton outline of the mechanism, the connecting rod $B\ C$ receives its motion through the crank $A\ B$, fixed rigidly to the 20 inch pinion, as shown. The center, A, of this pinion rotates about the axis B, and the pinion meshes into the 40 inch stationary internal gear, so that the pin B, and consequently the connecting rod $B\ C$, travel in a straight line in the plane shown in the drawing, the length of the stroke being 40 inches—the diameter of the internal gear.

This mechanism will be recognized by some as an application of Evan's parallel motion, but, for the benefit of those who cannot see why the pin B moves in a straight line, I would suggest that they describe a circle of any convenient diameter, and cut out a paper disk one-half the diameter of the circle, and roll this disk inside the circle. It will readily be seen that any point on the circumference of this disk moves in a straight line, on a diameter passing through the center of the circle.

Now, if the pin C travels 40 inches, it will, in turn, impart 40 inches of horizontal travel to the rack driving gear, but, by virtue of its resting on a stationary rack, it will transmit 80 inches of linear motion to the reciprocating table. It is required to give the 25-inch cylinder a peripheral velocity equal to that of the table at the point of impression I, for a period of time corresponding to the sum of the times taken by the crank-pin in traveling 45° on either side of the 90° position, shown in the drawing. It must be understood, of course, that this arrangement really supposes the connecting rod to be of infinite length, although a similar result could be accomplished if such were not the case. Motion is communicated to the machine through the shaft B, the latter having keyed to it a 40-inch gear, which, in turn, is driven by an 8-inch pinion. Meshing into the 40-inch spur gear is an intermediate gear, transmitting motion to a 20 inch gear, which has keyed to its shaft the first, or driving irregular gear, the second irregular gear being keyed to the shaft E, carrying the 25-inch cylinder. With an infinite connecting rod, a 20-inch crank will occupy successively the positions indicated by 90°, 85°, 80°, 75°, etc. If we assume the velocity of the crank pin as unity, the velocity of any point on the rod, $B\ C$, for any given angle of the crank would be proportional to the perpendicular let drop from that crank-pin position to the diameter. The maximum and minimum velocities are at 90° and 0° respectively, while for any intermediate position, as 50°, the velocity is represented by the ordinate c; the distance traversed by the pin C, from the center of the stroke, being represented by the distance $B\ 3$. The velocity of pin C, when the crank-pin is at 90°, is equal to the velocity of the crank-pin, or unity; but, in consequence of the rack-driving gear meshing into the stationary rack, it receives a circumferential velocity, equal to the linear velocity of the pin C. There is thus transmitted to the rack on the table a velocity of 2, when the crank pin is at 90°. The 25 inch cylinder must now receive a peripheral velocity equal to 2 for this angle of the crank, which we will call the initial position. The velocity on the periphery of the 20 inch gear being the same as the peripheral velocity of the 40-inch gear, or 40-inch crank-pin circle, we have, using x and y for the varying distances between the point of contact of the irregular gears and the centers of the shafts D and E respectively, a ready means of determining the pitch lines of the irregular gears. We will assume that we have two 20-inch gears (shown in dotted lines), and first find how much eccentricity must be given these gears, in order to produce the required velocity at the point of impression I, and then change the pitch lines of these gears to suit the varying conditions due to the constantly changing velocity of pin C.

The following equations express the conditions to be fulfilled: $x + y = 20$; $\frac{x}{10} \times \frac{12\frac{1}{2}}{y} = 2$. These equations solved simultaneously give $x = 12.308$; $y = 7\ 692$. $12.308 - 10 = 2.308$ (eccentricity). We are now certain that the velocity on the periphery of the 25-inch cylinder is equal to the velocity of the table at the initial position of the crank-pin. Since the velocity of the pin C, when at its initial position, is unity, the velocity at any other position, as at 85°, will be as the sine of the angle made by the crank at this position, and is represented, graphically, by the line j; thus the sine of 85° is .9962 (length of line j compared to line l). When the crank is moving through this angle, the pin C, or pin B, has traveled through the distance B 10, thus transmitting to the table a forward motion equal to $2 \times B$ 10. One turn of the 40-inch gear, of course, gives two turns to the 20 inch gear, but the circumferential pitch from 90° to 85°, on the 40-inch crank-pin circle, corresponds to the distance 90° to 80° on the 20-inch spur gear, and so on for all different pitches. These pitches are spaced off for every 10° on the 20-inch gear, and through these divisions radial lines are drawn from the center of rotation D. When the irregular gears are in contact at 80°, we have to fulfill the following conditions: $x + y = 20$; $\frac{x}{10} \times \frac{12\frac{1}{2}}{y} = 2 \times .9962$ Solving simultaneously for $x + y$, we obtain $x = 12\ 29$; $y = 7.71$. In a similar manner we obtain for the angles 70°, 60°, 50°, 40°, 30°, 20°, 10° and 0 on the 20 inch spur gear, the values $x = 12\ 24$, $y = 7.76$; $x = 12.15$, $y = 7.85$; $x = 12.02$, $y = 7.98$; $x = 11.84$, $y = 8.16$; $x = 11\ 62$, $y = 8.38$; $x = 11.35$, $y = 8.65$; $x = 11.03$, $y = 8\ 97$; $x = 10.62$, $y = 9.32$ respectively, and corresponding to the angles 80°, 75°, 70°, 65°, 60°, 55°, 50° and 45° on the crank pin circle. By marking off on these radial lines the different values of x, we will obtain the curve $o\ o''$. From the center D we describe arcs, from these different circular pitch divisions on the irregular gear, cutting the line of contact $D\ E$, and from the intersection of these lines, with E as a center, draw arcs as shown in drawing—the radii of these arcs are the values of y, found from the equations. Now cut off on these arcs, successively, the distances between 90°, 80°, 70°, 60°, etc., on the first irregular gear, and we will obtain the curve $m\ m''$, which will roll on the curve $o\ o'$.

According to this construction, these gears will roll together for each successive pitch; but we have not completed the pitch lines of the two gears—we have only satisfied the conditions required—and now we have to make the remaining portions of the lines $o\ o'\ o''$ and $m\ m'\ m''$ the same length, and see that the pitch lines roll together. This may be accomplished by assuming some arbitrary pitch line for the driving gear, and according to the method already described, draw the profile of a gear that will roll in continuous contact on the first or driving gear. A few trials will enable us to determine two profiles, equal throughout, and which will satisfy the required conditions—that the table and cylinder shall move with exactly equal velocities, while the crank-pin travels from 45° on the left to 45° on the right of the initial position, or $14 \times 2 \times 2 = 56$ (travel of table). Having obtained the pitch lines of the two gears, it only remains to give them an equal number of teeth to insure perfect working. The reason for not driving the 25-inch cylinder directly, with a gear meshing into a rack on the table, is that the cylinder makes more than 150 revolutions per minute. The momentum of such a large cylinder was found to be so great, that it was not practical to allow it to stop; but, by using a crank motion, the table is brought to a very gradual stop, and the evil effects due to momentum are entirely avoided.



Conforming Rotary Motion to Reciprocating Motion.

On Monday, April 30th, and Tuesday, May 1st, during the day and evening, there will be a large exhibit of drawings made by members of the free-hand, mechanical, architectural and carriage-drafting classes, also manuscripts from the penmanship, bookkeeping, shorthand and typewriting, arithmetic, steam engineering and electricity classes of the Young Men's Institute, 222 Bowery, New York.

Any one interested is welcome to visit the rooms, and inspect the work done by the pupils. On Tuesday evening, May 1st, the closing exercises of the classes will be held in the Institute Hall. Certificates of progress, diplomas and prizes will be awarded, and there will be special music and addresses.

The work of the school year 1893-1894 has been very satisfactory with an enrollment of about 635 young men in 11 studies, and the committee are planning to add one or two new subjects to the curriculum for 1894–1895.

The fall term will begin October 3, 1894. Enrollment can be made any time during the spring, summer or early fall.

It is proposed now to have bicycle racers ride at the rear of a cornucopia-shaped aluminum shell, which is to be mounted upon three bicycle wheels and driven by electricity. Immediately in the rear of this, it is claimed, there will be a vacuum, within which a bicycle rider will be entirely free of atmospheric resistance and can attain a speed of a mile in 1:15. And most sensible people who should see this done would, we think, be disposed to say fudge! or, possibly, something less polite.

There is, just now, a good deal of thought being given to profit sharing in the shops and factories of the country. Whether or not this is to be a solution of the labor problem, we cannot say. The best indication in the whole matter is the evidence that people recognize the fact that there is something to be solved.

Improved Double Glue Jointer.

We illustrate herewith a double glue jointer, which is so arranged that it makes two glue joints simultaneously and effects a saving in time and stock.

The frame or bed of the machine is cast in a single piece, cored and braced to give strength and rigidity, the top of this being planed true to receive the working parts of the machine.

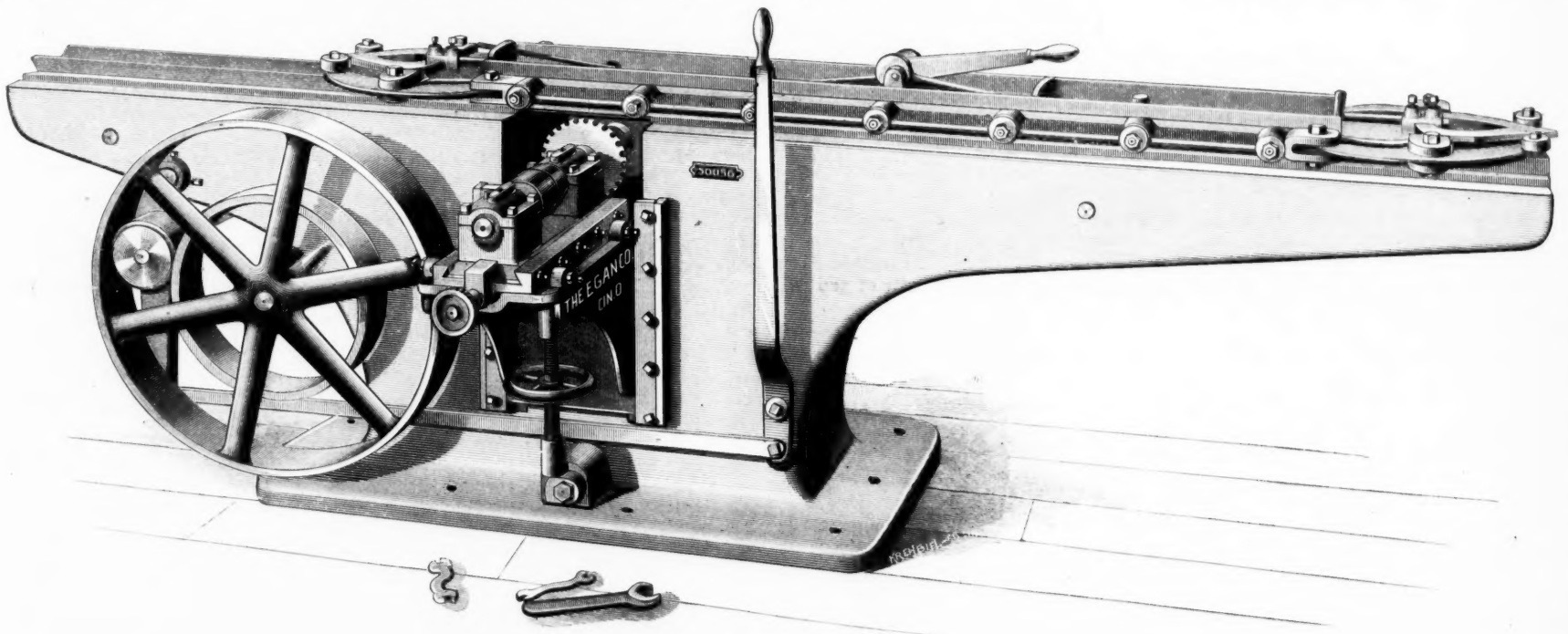
The mandrels are made of cast steel, are of large size, driven independently, and each carries a full set of saws or shimer heads, as may be preferred, making a matcher joint of almost any shape, and with an unusual amount of gluing surface.

The table is a single solid casting, planed to fit the bed and with means for taking up wear. It is also arranged for clamping two boards of uneven thickness and bring them to a straight line against the permanent center fence, this being done by a single movement of a lever.

The feed is entirely noiseless, and its rate can be changed at the will of the operator.

An ingenious automatic device controlled by the feed motion is provided for dropping the mandrel and boxes below the cut, while the table is being run back.

The capacity of the machine is two pieces of stock up to 6 feet 6 inches long, and from ¼ inch to 3 inches thick. Almost any shape can be jointed very quickly, and in the best manner, using any kind of wood. The machine is made by the Egan Company, Cincinnati, O.



Improved Double Glue Joiner.

LETTERS FROM PRACTICAL MEN.

The Schiele Curve.

Editor American Machinist:

Mr. Horton's article on "The Schiele Curve and the Friction of Thrust Bearings," in your issue of March 29th, is an interesting presentation of the curve and its peculiarities, but, in its application to thrust bearings, the statements and conclusions are so contradictory and misleading that they should not pass unnoticed. After defining the moment of friction, the author observes: "It is shown in mechanics that the moment of friction of any bearing is independent of the form of the bearing, depending only on the outer and inner radii of the bearing and the weight or pressure supported, or as a formula we may write $M = \frac{2}{3} f W R$ for a flat or conical thrust bearing, and $M = \frac{2}{3} f W \left(\frac{R_1^3 - R_2^3}{R_1^2 - R_2^2}\right)$ for a collar or Schiele bearing."

To those of us who have been accustomed to the use of conical surfaces for the purpose of increasing the moment of friction, it is rather startling to be told that a flat face will drive as well as a cone clutch under the same pressure; but again, in the last paragraph, we find a strange contradiction of the statement just quoted, in the following words: "The moment of friction of the Schiele bearing is the same as that of a collar bearing under the same conditions, and is less than that of a flat bearing having the same external diameter," yet the formulas given in support of the first statement indicate very plainly—though their correctness may well be doubted—that collar and Schiele bearings have a greater moment of friction than flat or conical bearings of the same external diameter. The question naturally arises, how the moment of friction can be independent of the form of the bearing, and where such a proposition is to be found in mechanics. Perhaps Mr. Horton can explain, meanwhile the friction of thrust bearings may be worth considering from a rational standpoint without dependence upon any authority known or unknown. Mistakes may be made, of course, and nothing need be taken on faith, for, as Josh Billings once observed, "It is better not to know so much than to know so many things that ain't so."

A variety of assumptions may be made respecting the distribution of pressure in thrust bearings. When the bearing is new, it may fit all over and the pressure may be uniformly distributed, or it may bear hard at one point and light at another, but when subjected to wear it is evident that the portions most heavily loaded will wear first and transfer thereby some of their load to other parts. It is evident, also, that wear results from motion under pressure, and in the absence of experimental data, it may reasonably be assumed that wear is proportional to the product of motion and pressure. The correctness of this assumption may be questioned, but not without injury to the pretensions of the Schiele bearing, and, for the purpose of analysis, it is now generally accepted without argument. This may be called the fundamental assumption in the modern treatment of the subject, while formerly—by Rankine and older writers—it was commonly assumed that the pressure on a flat step or collar was uniformly distributed.

Mr. Horton argues truly that the wear on a flat step or collar tends to relieve the outer portions and concentrate pressure toward the center, but the formulas given are based upon the assumption of uniform pressure throughout.

Letting p = pressure per unit of surface,

r = any radius within the step or collar, and f, W, R, R_1 and R_2 as used by the author of the paper in question, we have for a collar bearing:

$$W = p\,\pi\,(R_1^2 - R_2^2)$$

$$\text{or } p = \frac{W}{\pi\,(R_1^2 - R_2^2)}. \qquad (1)$$

Considering a circular element $d\,r$ of the collar at the radius r, we have for its area $2\,\pi\,r\,d\,r$, which, multiplied by p, gives the pressure $p\,2\,\pi\,r\,d\,r$, and this multiplied by the co-efficient of friction f, gives for the friction of the element $f\,p\,2\,\pi\,r\,d\,r$.

For the elementary moment of friction, we multiply again by r, and obtain the equation $d\,M = f\,p\,2\,\pi\,r^3\,d\,r$, which gives by integration $M = f\,p\,\frac{2\,\pi}{3}\,(R_1^3 - R_2^3)$, and substituting in this the value of p in equation (1), we have:

$$M = \tfrac{2}{3} f\,W \frac{(R_1^3 - R_2^3)}{(R_1^2 - R_2^2)} \qquad (2)$$

For a flat step bearing R_2 becomes zero and equation (2) becomes $M = \frac{2}{3} f\,W\,R_1$, or simply

$$M = \tfrac{2}{3} f\,W\,R \qquad (3)$$

as given by Mr. Horton.

Therefore, on the assumption of uniformly distributed pressure, the formulas in question apply to flat bearings of circular outline, and it seems almost unnecessary to say that they do not apply to conical or Schiele bearings.

In conical bearings the wedging of the cone increases the pressure causing friction by the cosecant of the angle between the generatrix and the axis; thus letting α represent this angle, equation (3) becomes:

$$M = \text{cosec}\,\alpha\,\tfrac{2}{3} f\,W\,R \qquad (4)$$

and equation (2) is similarly modified for a conical collar.

In the Schiele bearing, where a is the length of the tangent to the axis, the surface exposed to pressure between cylinders which differ in radius by the amount $d\,r$, is $\frac{a}{r}\,2\,\pi\,r\,d\,r$, or $a\,2\,\pi\,d\,r$, and multiplying this by $f\,p\,r$, we have for the elementary moment of friction $d\,M = a\,f\,p\,2\,\pi\,r\,d\,r$.

Integrating between the limits R_1 and R_2, we have

$$M = a\,f\,p\,\pi\,(R_1^2 - R_2^2), \qquad (5)$$

and substituting the value of p from equation (1)

$$M = a\,f\,W, \qquad (6)$$

On the assumption of uniformly distributed pressure between the rubbing surfaces, it will be seen that p is equivalent to fluid pressure, and that equation (1) holds good for any form of bearing.

From equations (2), (3), (4) and (6), it appears that in every case the moment of friction depends upon the form of the bearing, and that, in the case of the Schiele curve, it is independent of the outer and inner radii, the length of the tangent a being the governing factor. Making $a = R_1$, it also appears that the friction of a Schiele bearing is always greater than that of a flat step or collar of the same diameter. The misnomer, "anti friction," certainly could not find an application more absurd than this, and the question may well be asked, What is there in the Schiele curve to recommend its use for thrust bearings? Nothing that I know of, unless its use cultivates a taste for fancy shapes, and a scientific interest in the formation of curves having some peculiar properties, among which the most interesting feature here lies in the fact that, when applied to thrust bearings, the two assumptions of uniform pressure and uniform wear become identical, and lead to the same result as given in equation (6).

Now, in the case of flat bearings, if wear is the product of motion and pressure, the natural action of wear will finally cause p to vary inversely, as the radius r, and on this basis equation (2) would become

$$M = f\,W\left(\frac{R_1 + R_2}{2}\right), \qquad (7)$$

or equation (3) would become

$$M = f\,\frac{W\,R}{2}. \qquad (8)$$

There is no possibility of wearing any part of the surfaces out of contact, because contact is a necessary condition on which wear depends, and furthermore, there is no tendency in wear to alter the plane of contact. When pressure is relieved, the surfaces may, by virtue of elasticity in the material, assume an almost infinitesimal convexity of form, which again becomes plane under pressure, but it cannot be argued from this that flat thrust bearings tend to wear out of shape. In a flat bearing where R_2 is zero the maximum intensity of pressure is theoretically infinite or equal to the crushing strength of the material, and, to avoid excessive intensity of pressure, a portion of the center may be removed. If, however, R_2 be indefinitely increased toward its limit R_1, the intensity of pressure will again increase by reason of diminished surface.

Consequently, for any given value of R_1 there is a certain value of R_2, for which the intensity of pressure is a minimum, and it can easily be shown that this condition is reached when $R_2 = \frac{R_1}{2}$. As great intensity of pressure should always be avoided where good lubrication is desired, the conclusion to be drawn is, that flat thrust bearings should always be annular in form, having an inside diameter one-half of the external diameter. In this case, the maximum intensity of pressure, p_2, at the radius R_2, is expressed by the formula,

$$P_2 = \frac{2\,W}{\pi\,R_1^2}, \qquad (9)$$

and, for the minimum intensity, p_1, at the radius R_1, we have

$$p_1 = \frac{W}{\pi\,R_1^2}. \qquad (10)$$

In a Schiele bearing, where $a = R_1$, the uniform intensity of pressure, p, depends upon R_2, which must always be greater than zero in practice. For $R_2 = o_1$ at the limit, $p = p_1$, and, for $R_2 = .707\,R_1$, $p = p_2$, while for the average pressure $\frac{p_2 + p_1}{2}$ on the collar bearing, we have, in the Schiele bearing, $R_2 = \frac{R_1}{2}$. It would hardly be worth while to extend the bearing beyond this limit, and evidently the intensity of pressure in a Schiele bearing cannot be very different from the maximum intensity in an annular bearing of the same external diameter. But the moment of friction is always

less on the annular bearing, and the cost of production speaks for itself.

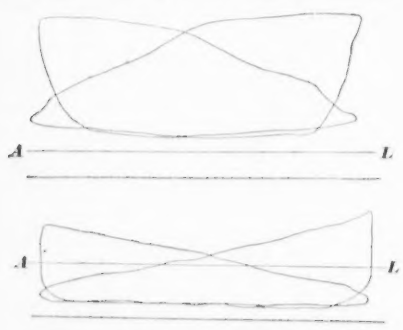
The Schiele curve is certainly ingenious and interesting, but its merits as a thrust bearing have been vastly overestimated, to say the least, and in these days of practical utility, such unfounded traditions should not be expected to continue in circulation as unvarnished truth. Everything must be subjected to the test of common sense, and, if the claims for the Schiele curve will not stand it, why not give them up, and let the curve enjoy the advantages which really belong to it on paper. Wilfred Lewis.

Automatic Cut-off vs. Throttling Engines.

Editor American Machinist:

I notice that Mr. Crane in his remarks published in your issue of March 8th, states in effect that the economical throttling engine is always a motor of small size, and in general, he refers to engines of 50 horse-power or under. While this may be generally true, neither this fact nor Mr. Crane's theory of leaking valves warrants the belief that it is impossible to make an economical throttling engine of large size. As a proof of this, I inclose a pair of diagrams taken some years ago from one of a pair of throttling engines, which, at the time the test was made, had been working for some years driving a cotton mill. As the collective power developed by this engine is nearly 1,000 I. H. P., it cannot be regarded as a small engine, but yet the results obtained are remarkably good. The high-pressure cylinders are 22 inches in diameter, the low pressure 40 inches, the stroke 6 feet, and the revolutions 38 per minute, giving the very moderate piston speed of 456 feet per minute. This engine is provided with plain slide valves without expansion devices of any kind, and is controlled by ordinary throttle valves operated by a common Watt governor.

I might mention that the test referred to was conducted by a leading English engineer, and may be taken as thoroughly reliable in every particular. At the time the appended cards were taken, the boiler pressure was 87 pounds; the mean effective pressure realized in the high-pressure cylinder 47.57 pounds, and in the low pressure 13.83 pounds. The power developed was about 485 I. H. P. for each side, while the coal consumed per I. H. P. per hour was 2.2 pounds. Of course, there are numbers of Corliss condensing compounds doing much better than this, but there are some doing a good deal worse. When it is considered that in the engine above referred to no precautions whatever were taken to secure economy in working, and also that both the steam pressure and piston speed

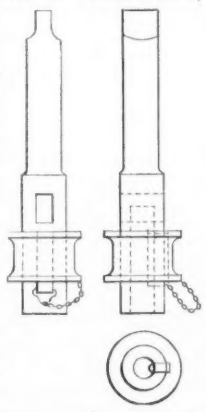


are only moderate—it will, I think, be granted that it is at least *possible* to make a throttling engine of large size which will give fairly economical results, and that at considerably less outlay in first cost and upkeep than the modern high class Corliss engine entails. One other point calls for remark. Throttling engines are for the greater part purchased by those who need an inexpensive and substantial motor, not likely to be easily deranged by the ignorant tinkering attendant. Cheapness of construction being the leading consideration of the maker, he does little or nothing towards improving the economy of his engine in any way, and it is therefore not surprising to find the throttling type of engine so universally despised. Moreover, being much in the position of a dog with a bad name, the throttler does not receive a tithe of the attention that would be given to your engine of many parts. With a material variation of load, the throttling engine cannot approach the automatic in economy, but with a fairly steady drive and a suitable load, there is much more to be said in its favor than is popularly supposed. M. E.

Drill Chuck Improvement.

Editor American Machinist:

In our business (Eames Vacuum Brake Co.) we use a great many twist drills from $\frac{1}{8}''$ to $3\frac{1}{4}''$, and the flat end or tang is often twisted off. Then the shank was turned down, and repeated breakages with repeated turning down often extended into the fluted part of the drill, which was then no good. To remedy this evil I took the Morse socket, cut a slot hole through one side, $1\frac{1}{4}''\times\frac{1}{4}''$, and fit a flat key in with the lower edge half round, to fit into the drill shank, which had a half round groove milled in it. A sleeve or collar was made with a keyway cut in the inside, the same taper as drill shank. The key being straight, the taper of the shank gave the right taper for the collar to slip



over it; the weight of the collar kept it from working up, and it held the key in the drill shank. I have used this socket for some time, and we have forced a $1\frac{1}{4}''$ drill with all the power we could, but the key held it solid. I send sketch of it; I see one described in American Machinist got up by the Cleveland Twist Drill Co., but we think ours more simple and cheaper to make; the key is fastened to the collar by a small chain so as not to get away, and it is "as handy as a pocket in a shirt."

Watertown, N. Y. John J. Bingley.

A Dangerous Element in Fly-wheel Construction.

Editor American Machinist:

I have a profound respect for the professional engineer. His presence always impresses me with a sense of reverential awe, and yet misgivings will creep into my mind as to whether his equations are always really equal. In spite of my better judgment I cannot dispel a feeling of insecurity when passing over a high and apparently flimsy trestle, or when ascending several stories in a jerky elevator, wondering in the meantime whether these sudden strains entered into the engineer's calculations when his factors of safety were determined. Let such skepticism be founded on good or bad judgment, it is evidently allied to a sort of horse sense, such as this animal manifests when approaching a structure that has not been tested by his weight. The skillful engineer in designing his various structures doubtless relies much on ample factors of safety, but what is he to do when the nature of the case will not admit of such protections being used? Electrical engineering furnishes examples of this kind, and indeed they are found wherever high speeds in machinery are required. We refer more particularly to the frequent failure of pulleys and fly-wheels, resulting as they often do in great loss of life and property.

In the American Machinist of February 1st, Prof. Joseph Torrey treats the subject of fly-wheel construction in a very able manner. To this we can add nothing, further than to point out a dangerous element which often enters into the construction of fly-wheels and pulleys, namely, counterbalances.

Of course, disastrous explosions of both boilers and fly-wheels will occur so long as boilers run dry and steam engines run away. But pulleys and wheels do burst when their speeds are only slightly accelerated above the normal, showing that a very narrow limit often exists between their regular speed and that necessary to burst them.

An example of this kind came to our notice very recently. A cast-iron pulley six feet in diameter and speeded at 300 burst into fragments. It was employed on a countershaft between the engine and a large circular saw. At the time the accident occurred the saw was not cutting, so we may infer that the speed of this pulley was slightly accelerated. The engine is controlled by a throttling governor, which probably allowed of a variation of about 10 per cent. in speed. From this it is seen that the periphery velocity of this pulley at regular speed was about 90 feet per second; it burst at a speed of 100 feet, or at most 110 feet. From this we may see how small a factor of safety existed in this case.

It is generally understood, we think, that the weight of a fly-wheel cuts no figure in giving it strength to resist centrifugal force. Professor Torrey says, "Every pound adds just so much to the strain as it adds in holding power." Yet it does make a difference whether or not the metal in the rim, be it thick or thin, is of uniform thickness on all sides. In practice, we find a good deal of variation in this—sometimes the result of bad molding, but oftener caused by careless chucking when the wheel is bored. Of course, such pulleys are balanced by attaching a sufficient weight to the light side, but herein lies a potent element of danger. A weight which produces a bursting strain, but adds nothing to the strength of the rim to resist its action. In view of this, it does make a difference whether the rim be thick or thin, for although the balancing effect of this weight is as though it was equally distributed over the whole surface, yet its centrifugal force is concentrated at the point where it is attached, and may be sufficient to cause a rupture that will result in a total wreck. Take, as an example, a pulley six feet in diameter with a counterweight of 30 pounds on one side, the wheel makes 300 revolutions. To use the usual formula for determining centrifugal force, we have $\frac{300^2\times 6\times 30}{5{,}870} = 2{,}759$ pounds due to the weight alone. When this is brought to bear on a light rim already weakened by rivet holes, and strained by the force of its own weight, to say nothing of unequal strains that may exist in the casting, we need not be surprised when such a pulley goes to pieces.

Of one thing we may be sure, that modern practice with highly speeded machinery brings us right along the danger line, with very little, if any, factor of safety to rely upon. As a further evidence of this, we may refer to an incident that took place but a few days ago. The writer was grinding at an emery wheel when, with a loud crash and in a cloud of dust, the wheel on the other end of the mandrel flew to pieces, one of which was sufficiently large to make a hole through the roof. There is nothing like an object lesson to impress one with the destructiveness of the hidden forces that lurk in every turning wheel.

"Quirk."

A New Statement of the Defective Casting Question.

Editor American Machinist:

We make our best bow to Mr. West in view of his extended reply to our letters in the American Machinist as to the cause of blow holes in castings.

His criticism of our use of his expression, "smooth concave indentations," has some weight, but as these "inner and outer blow-holes" "can both result from improper liberation of gases," we will not pursue further the question of terms, but proceed directly to the subject in hand.

Our first question was, "Is it possible for these defects [*i. e.*, blow-holes] to arise from the quality of the pig-iron we use?" Several of your correspondents, including Mr. West, think we should have given more details of our molds and castings, but we purposely made our question so broad that it could be answered without any knowledge of these details, in order that it might be more interesting and instructive to all molders and foundrymen. And we supposed that some one who knew would stand up and say decidedly *yes* or *no* to such a question. But, so far as the discussion has gone, the question seems to be getting more and more unsettled.

Our last letter, in which we took opposite ground from all former correspondents, and claimed that the blow-holes might arise from something wrong with the iron, was written with much fear and trembling, for we knew that we didn't know much about it, and we expected to have the wind taken out of our sails by the first man that came along who could speak with authority. But we feel much relieved after reading the two replies that have appeared. Both Mr. Beckwith and Mr. West advise us to have our iron analyzed, and otherwise indicate that the trouble may come from the metal.

Mr. West starts out with the opinion that "there is a slight probability of our iron causing such holes," but further on he says: "I cannot bring myself to believe such to be the cause." But later his "slight probability" revives and grows to a "strong probability," and he says, referring to the fact that iron sometimes bubbles and boils in the ladle, "there is a *strong probability* of something being wrong with the metal when it acts like that," and he closes by saying, "If our pig metal shows a rough surface and has holes in it [which it does and has] I would be led to say it was not a desirable metal to expect to obtain good castings from."

Now, leaving your readers to reconcile and digest these expressions, we wish to take Brother West by the hand, while we quote again from his letter: "I do not at all like the idea of giving an ear to such a doctrine, as it opens up such a grand opportunity for offering excuses to evade the responsibility for turning out good work."

We feel very keenly the force of every word of this. We know that, as it is now, molders have little difficulty in finding a good excuse for any and every defect in their castings, and it seems perfectly needless to add another one to their list. Still we wish to know "the truth, the whole truth, and nothing but the truth," no matter who it hits or how hard it strikes.

We are much interested in that part of Mr. West's letter in which he explains the action of sulphur in pig-iron. Does he mean that sulphur exists in the molten pig in a gaseous form, and is thus "caught by the liquid metal solidifying before the sulphur had time to escape" and thus causes "the top or face of the pigs to be honey-combed"? And does he mean to intimate that when the molder finds the top of his casting to have holes in it, that these holes may originally have been full of sulphur, which was thus caught in its endeavor to escape upwards?

We will close by propounding our question anew in a slightly different but more definite form, and hope to hear something more decisive upon it *Is it possible for blow-holes in castings to arise from some defect in the pig iron from which they are made?*

W. H. Drake.

About Drilling.

Editor American Machinist:

I note in your issue of March 15th the remark that "a boy who never spoiled a drill was not worth much;" or words to that effect. Well, the boy who never broke a drill is like the one who "never told a lie;" he is a rarity. And as to the cause of the drills breaking it cannot so often be ascribed to a wish to ascertain how much it is safe to force a drill as to improperly clamped work, imperfect lubrication, or dull drills.

I have run drill presses of several makes, and where I was careful to provide against the above points, have often forced drills until the belt slipped without breaking them. Small drills have not this strength, but, as a rule, drills stand more use and abuse than any other machine tool.

I spoke of a belt slipping; have in almost all such cases seen rosin thrown on the belt as a remedy. I think this is a quack cure. It does good temporarily, but shortens the life of the belt. The worst enemy of belts is oil, which gets on them in many ways,

soon rendering them flabby, ruining them. Where belts can be kept dry a little castor oil now and then will make them stick and prolong their life.

To go back again to drills. In a chucking machine in our shop where a large number of cored castings had to be bored, many drills were broken. A set of flat drills was ordered, and these do the work well and don't break. This is because they don't get caught and pulled in as twist drills will do in work of this character.

I remember another case in which a flat drill was used to great advantage. I was running one of Jones & Lamson's 2x24 flat turret lathes, and had to cut off lots of pieces of tough 2 inch round iron, in one end of which a hole 1½ inches diameter and 2 inches deep had to be bored. A 1½-inch flat drill was made for the job, which was done as follows: The work was run fast, and a $\frac{5}{16}$ inch drill run in to the required depth; then the work was run slower, and the flat drill run in, using a very heavy feed.

I was astonished at the rate at which I could turn out these pieces, and the heavy feed I could use with that flat drill. Though I haven't tried it I think a twist drill would have taken twice the time required for these two operations.

The old machinist's method of preventing blow-holes in castings by "slinging billingsgate" at the founder, recalls a similar experience. We got a lot of castings, as in

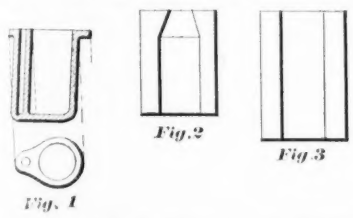


Fig. 1

Fig. 2

Fig 3

Fig. 1, of which many were worthless. When bored they always let in daylight near the bottom of the bore, as indicated by dotted lines, not because they ran out of true, but because the metal was very thin at this point.

I went to the founder; he blamed the patternmaker. The core box was as I have roughly sketched it in Fig. 2; he said it should be as in Fig. 3, so that the core could be firmly anchored in the cope.

The patternmaker, when I saw him, said the founder didn't know his business, but if we decided on a new core-box he would like the order. My boss said he didn't propose to get a new core-box; some of those castings were good, and he didn't see why they were not all good. He went to the foundry—swore until the air was blue and sulphurous—and not another bad casting.

This method is good—very good for emergencies, but I wouldn't recommend it for common every day use. Swearing is an awfully bad habit. THE CUB.

"Locomotives as Stationary Engines."

Editor American Machinist:

The AMERICAN MACHINIST of March 29th contains an editorial on "Locomotives as Stationary Engines" which deserves more than passing notice from engineers who are moved to enthusiasm by occasional brief spurts of great indicated power from these engines. The editorial in question bears evidence of having been written by one who has given this subject careful thought from the standpoint of a varied experience with stationary engines and a thorough knowledge of the limit to locomotives.

In discussing this question one must keep in mind the wide difference in the service of these types of engines, and which the writer of the editorial has done; he has gone still further and analyzed the demands which make these types so distinctly different.

The locomotive of to-day is one of the best adaptations to fixed conditions known in engineering annals. Few cases can be cited where conditions are more arbitrary in their demands and so difficult to meet as in the motive department of American railways. The difficulty of the locomotive designer is not so much to produce a motor of great power, as to make one which must be confined to such limited space, and this is not all, for his requirements call for all grades of power from the switching of a single car to haulage of 50 car trains over heavy grades, with an occasional demand, for a few minutes only, for the development of a possible 1,500 horse-power. All these conditions are obstacles to steam economy from the standpoint of the factory and electric plants.

Locomotives use steam economically only from the railway standpoint, and all attempts to make their coal records for horse-power equal those of non-condensing stationary engines have resulted in failure.

Steam economy is the result of harmonious functions wherein all parts do their best simultaneously. This is impossible in locomotive construction. According to Mr. Forney, there are cases on record where from 190 pounds to 200 pounds of coal are burned on (or supplied to) each square foot of grate surface.

Here is a case where the boiler may be said to be at its best in the way of quantity of water evaporated; but how is it with the engines under such conditions? Such intense combustion is possible only with a draught that comes at the expense of full-stroke cards, or with little steam expansion.

When the boiler is at its best the cylinders are using steam at a rate which would burn the factory's dividends, and it is only under such conditions that we may expect such phenomenal records as 1,500 and 1,800 horse-power from a locomotive, and this for a very short interval. On the other hand, we have the paradox of cylinders working steam most economically with a 1,800 horse power boiler unable to supply them. It is well known that steam cannot be expanded in locomotive cylinders to the extent that is called for in stationary engines, for the exhaust would not be sufficient to give the required draught.

Under favorable conditions the standard locomotive boiler is fairly economical, but such conditions would reduce its power from a possible 1,800 horse-power for a few minutes, and a possible average of 600 or 700, to about 150, and the latter condition would be with a draught suited to economical combustion of coal. The average duty of locomotive boilers in service on the road varies from 5½ pounds to 7 pounds of water per pound of coal burned. If these boilers are to supply mill engines their duty must be raised 25 per cent., which can be done only by reducing their great steaming capacity.

Commodore Loring's suggestion, at the engineers' meeting, that locomotive boilers showed a tendency to prime in marine service was interesting as an indication of what we may expect where any of the peculiar conditions of locomotive practice are changed. Locomotive cylinders are supplied with very small steam pipes and ports, so small, in fact, they will draw steam to an extent that would not be permitted in stationary or marine service. These small pipes are not the result of ignorance on the part of the designer, but are compulsory because of the limited steam room in the boiler. If steam pipes as large as used in stationary engines supplied the cylinders of locomotives, a piston speed of 1,000 feet per minute, with a full throttle, would draw water from the boiler faster than a pair of injectors would supply it.

The single-valve automatic stationary engine has all the qualities of locomotive engines; it is high speed with large clearance and its indicator diagram is similar in appearance to one from a locomotive. In each case the release and compression are variable, and are influenced solely by the point of cut-off. This type of engine is quite as economical in construction and in the use of steam, under similar conditions, as the locomotive cylinders. It has been on the market since 1881—long enough to test its economical qualities thoroughly. It has been very popular in electric lighting, and is to-day in smaller sizes. But in larger sizes, from 150 horse-power up, the demand is now for a more economical engine. The builders of single-valve automatics have, in nearly all cases, resorted to compounding to meet the demand for economy, but in some cases they have designed new types with less clearance.

It seems strange, in view of the fact that an engine with all the qualities of the locomotive, and in many cases with steam pressure quite as high, has been tested on the market a dozen years, and is now giving way to more economical types, that the locomotive, or a modification of it, should be seriously considered as an economical prime mover for factory purposes. The very fact that it is so well suited to the varying conditions of the railroad is evidence that it will not do for the more constant and favorable conditions of stationary power plants. HARRIS TABOR.

The Locomotive and the Stationary Engine.

Editor American Machinist:

"M. E." inquires where there is any mention of experiments with long and short indicator pipes.

My impression is there is but little said about it in books, and the most the writer knows of it is the trials among engineers themselves and debates in engineering societies.

I presume that considerable could be found on the subject in the Boston *Journal of Commerce*, of about 1883, and the *Manufacturers' Gazette*, the year following. It was from this latter that the cards were taken. The talk at this time will probably result the same as that, as about 90 per cent. will conclude that the long pipes are sufficiently accurate for their purpose, and being more convenient, will be used; 5 per cent. will use as short connections as possible, and the other 5 per cent. will use one or the other, as most convenient.

Some cards were shown me last week where it would be immaterial whether long or short pipes were used; the setting of the valves could not be much worse, and it may safely be said that where lead is given you can use a long pipe just as well as a short one. If the refinement of valve setting is not cared for, don't bother with the short pipe.

Locomotive men look upon the money laid out on steam plants as a lavish outlay, and point to the cost of a 1,000 horse-power locomotive. The locomotive is a marvelous machine. When the work it does and the conditions of that work are taken into account, it is really wonderful.

On the other hand, are the men that have made the study of economy in expenditures a business, and have calculated to a nicety the cost of the plant, the cost of maintenance, the delays from repairs, and all the items that will likely go into it for twenty or thirty years.

One thing about a locomotive, it is not an economical machine. With coal at $4 per ton, a 1,000 horse power locomotive would cost not less than $75 for a ten-hours' continuous run at full load. A 1,000 horse-power stationary engine should be run for $32 per day, a difference of $12,900 in three hundred days. This amount, at 6 per cent., would admit of a first expenditure of $215,000. Then take into account the probable life of the plant, and delays from repairs, and one can see that when the electric current takes the place of the steam locomotive, the current will not be supplied from generators driven by locomotive engines and boilers.

Place the locomotive in position so that it could receive the same care, and get the advantages of condensing water and the like, it would do some better, but it would be severely handicapped even then.

There is a place for everything, and the locomotive splendidly fills its place. Don't take its glory from it by putting it in a place it can never fill. W. E. CRANE.

An Oil Meter.

The increase in the use of oil for fuel and other purposes has made very necessary the employment of some means of measuring, with a considerable degree of accuracy, the amounts used for the various purposes. Particularly is this the case where the oil is being fed to burners and in certain situations around gas works. The Worthington "special" oil meter shown in the accompanying cut * has been designed with special reference to the measurement of extremely small quantities of oil or other fluids under light heads, where the amount to be measured does not exceed one gallon per minute. The size of the pipe opening is ¼ inch. The space occupied by the meter is 6x7x8 inches, and its weight is 12 pounds. The principle on which the meter operates is the same as that of the standard Worthington water meters, which have been used by the leading water companies of the United States and Canada for the past forty years. This principle is the reciprocation of two plungers, each stroke of which is marked on the counter, making the meter positive; and as a result, the fluid required to be measured cannot pass through the meter without registration, nor can the machine over-register. In these important respects it differs from meters of the inferential and rotary types.

AN OIL METER.

The entire meter and its moving parts are constructed of a special composition. It is very delicately adjusted and will register almost on drops. For the measurement of oil used in connection with oil-burning apparatus, and in all situations where it is desired to obtain an accurate record of the consumption of small quantities of oil and other fluids, this machine will be found quite invaluable.

A full line of Worthington motors is also manufactured for the measurement of crude oil, petroleum, naphtha, benzine, kerosene, etc., in any quantity.

Wasting Natural Gas in Indiana.

"The waste of gas in the Indiana gas belt is a downright shame and should be stopped," said Henry A. Smithson last night. "I have just finished a trip through Indiana. At all the small towns gas pipes stand erect with tongues of flame darting from them, making the surrounding country almost as light as day. Thousands of feet of gas are monthly wasted in this manner. If proper gas fixtures had been put in at a small cost much valuable lighting gas would have been saved. We hear frequently that in certain localities gas wells have given out Is there any doubt of it? These people who had wealth at their doors are deliberately wasting it in the exuberance of spirit over the boom it brought to their towns. Without this gas the boom must collapse. It takes this gas, figuratively speaking, to keep the boom balloon in the air. It is a shame that such a waste is tolerated."—*The St. Louis Globe-Democrat.*

We repeat for the hundredth time that in order that a reply to a correspondent may be certain, we must—in a large city—have his address, street and number. For reasons of our own we answer more questions by mail than through our columns. Unless one is in the way of receiving a large number of letters, an address as simply Detroit or Philadelphia is entirely insufficient. We mention this at this time because we have a rather unusual number of letters to which we cannot reply through lack of complete address.

* Henry R. Worthington, 86 Liberty Street, New York.

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CONTENTS.

	PAGE.
Automatic Gear Cutter	1
A New Arrangement for Taper Attachment	1
Compound Radiator Valve	2
Tool Dressing. By B. F. Spalding	2, 3
Improved Vise and Heel Clamp	3
Emery Grinder	3
Improved Vernier Caliper	4
Conforming Rotary Motion to Reciprocating Motion. By Frank DeW. Randolph	4
Improved Double Glue Jointer	5
Letters from Practical Men: The Schiele Curve. By Wilfred Lewis. Automatic Cut-off *vs.* Throttling Engines. By M. E. Drill Chuck Improvement. By John J. Bingley. A Dangerous Element in Fly-wheel Construction. By "Quirk." A New Statement of the Detective Casting Question. By W. H. Drake. About Drilling. By The Cub. Locomotives as Stationary Engines. By Harris Tabor. The Locomotive and the Stationary Engine. By W. E. Crane.	5, 6, 7
An Oil Meter	7
Wasting Natural Gas in Indiana	7
The Union Pacific Decision	8
About Boiler Plates	8
Literary Notes	8
Questions and Answers	9
Profit-sharing	10
Crucible Furnace for Burning Petroleum. By W. E. Crane	10
Death of George S. Lincoln	10
Improved Pipe Threading and Cutting off Machine	10
A Mean Swindle	10, 11
Laying out Patterns for a Blast Pipe. By Geo. Guntz	11
A Novel Time Glass	11
On the Wyoming "Flyer."	12
Manufactures	12, 13, 14
Machinists' Supplies and Iron	14

The Union Pacific Decision.

Judge Caldwell's decision in the matter of the proposed reduction of wages on the Union Pacific Railroad is hailed with delight by the employes of the road.

When boiled down the decision seems to mean simply that a plain contract or agreement entered into between a railroad company and its employes must be lived up to, and that this particular one at any rate is binding upon the receivers of the road.

We do not understand that the decision means that no reduction of wages can be made, but simply that no such reduction can be made arbitrarily, without notice or conference, or without regard to the agreement previously entered into between the company and its employes.

The receivers of the road seem to have taken the view that all that was necessary to bring about a reduction of wages was their dictum, regardless of agreements. This did not seem to be good in ethics, and it now proves not to be good in law, a decision which will go far, we think, in increasing respect for law on both sides, and will help in the settlement of future wage controversies.

Some surprise has been manifested, it seems, by one of the receivers that the court did not order the restoration of the wages of unorganized employes as well as the organized ones. But if the whole matter rests upon a written contract, and the employes have no ground for contention outside of the terms of that contract, how can the court extend its decision to cover the affairs of men who were in no way parties to it?

The question decided was not whether wages ought or ought not to be reduced, *per se*, but whether or not an agreement made between the company, and certain of its employes, should be lived up to by the receivers.

About Boiler Plates.

An act of Congress, recently passed, provides for the inspection and marking of boiler plates, and their stamping by the Government inspectors at the works where plates are made. This is certainly an important regulation, and one that will save a good deal of trouble for boiler makers. The quality is an element of manufacture, and is assumed and assured by the maker, and certainly the best and most convenient way is for the inspectors to examine and pass upon the work before it leaves the manufacturer's hands. If the plates pass out to merchants, and then to boiler makers, any fault of class or marking must follow back to the original makers in any case, or ought to, and certainly that is the proper place for inspection. There is a penalty of $1,000 and imprisonment for fraudulent marking. The Act had its origin among the Pittsburgh manufacturers.—*Industry.*

Outside and beyond all the laws that can be enacted and enforced in regard to the material of which boilers are made, stands the law of common honesty—the law of common honesty, older than all the statutes in the universe. Common honesty embraces all that is fair and just, and never looks for what is in the way of doing this or doing that. There are manufacturers of boiler plate that will give the manufacturer just what his specifications call for, and there have been such since the making of boilers became a standard business. The writer has had abundant evidence of this, going back through 25 years of experience. In other words, for 25 years there has not been a time when a manufacturer could not get just the quality of material he desired to put into a boiler, by paying a fair price for what he got.

But there are plenty of manufacturers of boiler plate who will give the boiler manufacturer what he is willing to pay for, and this is where the curse of poor boilers comes in. There is the sharp, hard competition, and along with this goes the poor material and the poor workmanship, and inspection and laws—all that can be devised—can never prevent it. The maker of boiler plate has to meet this one-quarter or one-half cent offered in price, and he has to offer lower price and poorer material or go out of business. That is exactly the way the boiler business stands to day, and it is just the way it will stand ten years from to-day unless something besides laws of Congress or State Legislatures steps in to make things better. Those who hang their hopes on legislation are likely to make the mistake that is as old as legislation itself. A law that will reform human nature—a moral law—is the only one that will materially remedy the matter.

It is coming more and more to be the fashion in this country to depend upon the integrity of the manufacturer of boilers—and other things—and less upon such hasty inspection as can generally be made. A man always pays a debt of honor, and when he is put upon honor in any way he will, on the same ground, stand up to what is right. There is, or ought to be, something for manufacturers and buyers of machinery in all this. If one man owes another something, the exact terms of which are covered by a document drawn in accordance with the provisions of law, he will argue that these provisions shall govern the case. If the transaction is one of honor, he will do what is honorable so far as he can see it. Men who will "go back" on their word, given in honor, are not so plentiful as is sometimes supposed. But when it comes down to the law of detail, covering every little point and hedging here and there, most men will consider their duties concluded by the interpretation of the law. If you want a new machine built, complicated in its nature, you can sit down with the mechanical representative of the firm which is to build it, and arrive at a certain understanding in the matter. A few lines in the way of an agreement is all that is required. Both parties being honest, read between the lines what it is impossible to state in them. You are now dealing with honest men who base their transactions on the broad principle of honor. Change the case, and deal with men who recognize nothing that is not "nominated in the bond" and trouble comes.

If there is any moral in all this—and we think there is, especially for men in the machinery line—it is: deal with men who will keep their word, especially in regard to things which the law does not compel.

Literary Notes.

A PRACTICAL TREATISE ON THE STEAM ENGINE. By Arthur Rigg. Second edition.

This edition is a revision of the original work which has gained for itself a well-deserved reputation for its simplicity, reliability, and usefulness. The work is not essentially a book for students, in fact, it is not in any sense an elementary treatise or history of the steam engine. The author does not enter into the domain of locomotive or marine practice, but confines himself to stationary engineering, giving details of construction with the principles by which their relative proportions may be calculated. Mathematical forms of expression, which are unfamiliar to practical men, have been avoided as much as possible, and graphic methods of calculation brought into prominent use, giving the work a merit of simplicity well adapted to the use of the busy engineer and practical men who are familiar with the more elementary principles of mathematics. The general principles of engineering which should be observed in any particular design, and which never change, no matter how much the design of an engine may change, are clearly demonstrated; in fact, this seems to be the principal character of the book.

The first chapter treats on systems of measurement; the second, on matter, force and motion. The third chapter is devoted to descriptions of horizontal steam engines; and the fourth deals with descriptions of, and notes on cylinders, pistons and piston rods. The next two chapters are devoted to theoretical investigations of slide valves in many of their endless modifications, and methods of arranging them, which are based upon Dr. Zeuner's simple diagram, and which has been worked out into a form easy and convenient for ordinary practical requirements. Lubricators and lubrication; parallel motions; pedestal and wall boxes; fly wheels; steam engine governors; indicator; influence of the velocity of reciprocating parts of steam engines; designs with short descriptions, of the more important modern classes of stationary engines, and examples of the high-speed class, particularly in their relationship to electric lighting, and triple expansion engines; heat and steam; and general principles which will serve to guide an engineer in the ever-varying requirements of his profession, form the subjects of the remaining chapters of the work.

The typographical work is very good, but some of the illustrations are not up to the present standard of illustration, as might be expected in books of such value as this one; it gives an impression of carelessness. It is also to be regretted that the steam ports of the upper cylinder in the Westinghouse engine, shown on plate 99, are not correctly placed. This is probably due to an incorrect blue print, a copy of which came to our hands before this book appeared, and which had to be corrected before we illustrated the engine in our issue of November 23, 1893. But on the whole, the book will be a valuable one in the hands of students, engineers and practical men.

The book is published by Spon & Chamberlain, 12 Cortlandt street, New York. Price $10.

The *Journal of the Association of Engineering Societies*, for January, 1894, has just been issued. The delay of its appearance has been unavoidably due to the transfer of the publication office from Chicago to Philadelphia, and the necessity of starting up anew of all the machinery for publication.

The make-up of the journal is much improved, the size of type is increased, and the size of page is now 9x6 inches, agreeing with the size of pages of technical literature published by other engineering societies. A department of notes and communications, under the title of "The Contribution Box," and one of book reviews, under the title of "The Library," have been added. Articles relating to little matters, hardly of sufficient dignity or bulk to form the subject of a formal paper, which yet often rival, if they do not surpass, these more venerable documents in interest and utility, will be admitted in the contribution box, and no doubt this department will be a very interesting and valuable one. In the library department it is proposed to notice briefly such engineering publications as may find their way to the office of the journal.

The present number contains a memoir and portrait of James B. Francis; a memoir of A. W. Locke; "Landslides," by D. Molitor; "Water Supplies," by W. Kiersted, and an article treating on a "New Prismatic Stadia," by R. H. Richards.

The journal is published monthly by the Board of Managers of the Association of Engineering Societies; John C. Trautwine, Jr., Secretary, Franklin Institute Building, Philadelphia, Pa. Price per number 30 cents, or $3 per year.

The tenth volume of the "Transactions of the American Institute of Electrical Engineers" has been issued. It contains the reports of ten meetings during 1893. It is scarcely necessary to say that this volume is an exceedingly valuable one to all interested in electrical engineering. It is published by the Institute at its office, 12 West Thirty-first street, New York City.

Since our notice of the book treating on heat and steam, by Charles H. Benjamin, has appeared, we have learned that the price of the book is 85 cents, and copies can be had by applying to the printer, C. H. Holmes, 1964 Euclid avenue, Cleveland, Ohio.

Rapid-fire guns have now attained a caliber undreamed of a few years ago, and one recently completed at the Washington ordnance shops is of 6-inch caliber. It uses a metallic cartridge and the weight of the

projectile is about 100 pounds. As guns of 4 inch caliber and similar design have been fired 10 shots per minute, it is expected that these 100 pound shots will be thrown with a—to the enemy—somewhat bewildering frequency, so to speak.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(184) R. E. C., Marlboro, Conn.: Your question is out of our line.

(185) K., Marietta, O., writes: I would like to know where knives are made that are used in making wooden butter dishes, I mean those which are cut out of a solid block of wood. *A.*—Write to any manufacturer of wood-working machinery; the addresses of some of these are given in our advertising columns.

(186) A. H. R., Cincinnati, O., asks: Is there a book published giving hints on lathe and vise work. If so, from whom can I obtain it, and what is the price? *A.*—"Modern Machine Shop Practice," by J. Rose, may suit you. It is published by Charles Scribner Sons, New York. It is sold in 30 parts, at 50 cents each.

(187) G. M., Natick, Mass., writes: Kindly inform me if there is a book published in pocket form that gives rules of geometry, trigonometry, mensuration, and tables of sines, cosines, and any other handy rules for machinists. *A.*—"Mechanics' and Engineers' Pocket book," by Charles H. Haswell, published by Harper & Brothers, New York.

(188) W. B., Platteville, Wis., asks: Which is best to use in a 6 horse power boiler, hard water containing considerable lime, or rain water? *A.*—Never use water containing a considerable amount of lime, as this will form a scale, and may give you considerable trouble. Rain water is the better of the two, and even with its use the boiler will need watching, as rain water is not always as pure as desirable.

(189) R. L. K., Lebanon, Pa., writes: I have a pulley or fly-wheel 10 feet diameter and 12 inches face; I want to know how fast I can run it without danger of its bursting. Please give rule for computing the safe speed. I would like to run the engine at the rate of 175 revolutions per minute. *A.*—For safety the velocity of the rim should not exceed 6,000 feet per minute. The circumference of a wheel 10 feet diameter is 31.41 feet, hence you may safely run the engine at the rate of $\frac{6,000}{31.41} = 191$ revolutions per minute.

(190) A. H., Chicago, Ill., asks: Will aluminum bronze stand a great amount of friction, and what are the qualities of the same in general? The bronze is composed of 85 per cent. of copper, and 15 per cent. of aluminum. *A.*—We cannot say what will be the qualities of such a bronze merely by knowing the proportions of the metals composing it. A foundry which makes a specialty of aluminum bronzes is The Waldo Foundry, Bridgeport, Conn. By addressing that concern, and stating your wants, you can probably secure what you desire. As to your other question, we think your design of bearing is preferable.

(191) J. K. N., Chicago, writes: In "Screws and Screw-making," page 131, by the Britannia Co., it is explained how cones or tapers may be correctly turned on a lathe by use of change gears and special mechanism. I would like to know if lathes in this country are often specially equipped for turning tapers in the same manner. Would you also kindly name whatever other machines besides the lathe and milling machine require change gears? I don't mean change gears simply to adapt the machine to the capacity of its work, but change gears for exact ratios. *A.*—Lathes are not often in this country arranged to turn tapers in this way, though it is sometimes done, as was the case with the 16-inch gun lathe built by William Sellers & Co. for the Washington gun shop. We do not now recall any important classes of machines, besides those you mention, that are fitted with change gears for securing various velocity ratios, though there are, of course, numerous special machines so arranged.

(192) P. A., Montclair, N. J., writes: In Question 166, E. E. M. asks: How many times one gear will revolve around its own axis in rolling around the circumference of another equal but stationary gear? Your answer is, once. This is not correct as it will revolve twice; one revolution is due to its motion of circular translation. This can be easily verified by two coins. It can also be made evident by imagining a lever fixed at one end and holding the gear by its center at the other. If now the lever be revolved, any point on the gear will be alternately over and under its center, although this center is fixed to the lever. *A.*—We admit that the revolving wheel makes two revolutions around its own center in rolling once around the fixed wheel, but we answered the question referred to from a mechanical standpoint, and assumed the axis to be a material body, such as a pin or axle around which the wheel revolves, and in this sense our answer is correct, the wheel will turn once around its axle in rolling around the fixed wheel. It must be admitted that this axle makes one revolution around its own center in moving around the fixed wheel, and, therefore, the loose wheel can make one revolution only about its axle, during the same time. In short, if the geometrical definition of the word axis is accepted, then the wheel makes two revolutions on this axis or center during the time in question, and if a mechanical definition is given to the word axis, then it cannot be said that the wheel makes two revolutions around its axis, the correct answer under these conditions is "*once.*" We have received letters of the same tenor from other correspondents, to which we can give no other reply than the above.

(193) M. B. C., Seattle, Wash., writes: Kindly inform us as to what the present practice is regarding the construction of large engine cranks and shafts. We claim that the built-up crank is a better one than that made in a solid forging, for the reason that there is not the same liability to defects in the material used in a built up crank that there is in a solid one. And further, if a built-up crank has sufficient metal allowed to securely hold the shaft and pin, it is as strong, if not stronger, than a solid forging, even though it might be perfect and without defects of any kind. We should like very much to have your opinion on this question. *A.*—The choice of these two types of cranks will depend in some cases on the work the engine has to do. Take, for instance, a marine paddle-wheel engine; for this a solid crank is out of question, on account of its rigidity; the crank-pin must be left loose in one crank, and firmly secured in the other. By these means the crank-shaft can adjust itself to the slight deflection of the hull, but which is sufficient to break a solid shaft. For other classes of engines, many engineers prefer the solid shaft for small engines, particularly when lightness is the object in view. When the shaft is 12 inches in diameter and over, it is better to use built up cranks, so as to avoid the danger of defects which are liable to occur in large forgings. But great care is required to properly construct such a shaft so as to be perfectly true when finished, and to have the arms shrunk on without leaving the metal around the pins and shaft ends in such a state of tension as to be dangerous. A built-up crank can be made strong enough to do the work for which it is designed, but we do not see how it can be made stronger than a solid one without defects, if properly designed.

(194) H. P., Abingdon, England, writes: What, in figures, is a driving and a working fit? I have read that $\frac{5}{8}$ inch rock per foot should be allowed for a driving fit, and $\frac{1}{2}$ inch for a working fit. What does this mean? This work is usually guessed at, but surely there must be some definite rule. *A.*—There is no definite rule for determining the allowance for driving and working fits, as much depends on the kind of metal used in the shaft, thickness, and kind of metal surrounding the hole, tightness of fit required, and, above all, much depends upon the sensitiveness of touch. The term "$\frac{5}{8}$ inch rock" means the amount of movement sideways in the hole of one toe of the calipers when the other is held stationary. For driving fit, we believe this amount of rock is too much. We prefer to have the toes of the inside calipers touch the opposite walls of the hole without any rock; then match the outsides to the insides, and turn the shaft so that the toes of the outsides will touch lightly. The amount of rock for a snug working fit depends on the diameter of the hole, and will vary from about $\frac{3}{16}$ inch for a 3-inch hole to $\frac{1}{4}$ inch for an 18 inch hole. The outside calipers are then matched to the insides, and the shaft turned so that the outsides will lightly touch the shaft. These sizes will have to be modified when the hole is much longer than the diameter. From the above it will be seen that considerable experience is required for making the different kinds of fits, and no definite rules can be given. 2. Suppose a cylinder is bored to 24 inches diameter, what must be the diameter of the piston? *A.*—This depends to some extent on the kind of packing used. But generally the piston head is turned $\frac{1}{32}$ inch less than the diameter of the cylinder. Sometimes less or more than $\frac{1}{32}$ inch is allowed, so as to suit individual experience or prejudice.

(195) J. W. C., Worcester, Mass., writes: Where or who are the makers of diamond drills for drilling steel (hard steel)? *A.*—You can obtain these drills from any first-class dealer in machinists' supplies, but you will be disappointed if you attempt to drill hard steel with them; they are not made for that purpose. 2. Can I use common house gas with a foot blower and blow-pipe to draw temper from hardened steel? *A.*—Yes. 3. Please give me directions for making a Bunsen burner, and saucer shaped sheet copper muffle as shown in Fig. 4 in your issue of September 7, 1893. Does the hole shown in copper disk run through the fire clay, or only through the copper? *A.*—The Bunsen burner consists of a small tube inserted into the bottom of a larger one; small holes are drilled in the larger tube a little below the top of the smaller one. Through these holes air is drawn into the larger tube by the current of gas escaping from the smaller one; by these means the air and gas are mixed and burnt at the upper end of the larger tube. Means are provided for regulating the amount of air. With a moderate amount of air the gas burns with a luminous flame. But if a strong steady current of air enters, the carbon is rapidly oxidized; the flame loses its brightness, and burns with a pale blue light, but with an intense heat. The size of the burner depends on the purpose for which it is to be used. From the above description you can easily design one; the manner of putting it together will suggest itself in making the drawing. It seems to us that you can buy one for less money than the cost of making one. The hole shown in the copper disk, we believe, runs through the fire clay. No directions for making the copper disk are needed; any coppersmith will make one for you in a few minutes. We cannot give any further information on safe burglary than is contained in the article referred to; it is out of our line of business.

(196) C. B. S., Hyde Park, Mass., sends us the following clipping: "Train and cannon ball compared. If you will sit down and figure on the subject a little, you will express less wonder when you hear of how the next head collision smashed things up. A train running 75 miles an hour moves along at the rate of 110 feet per second and exerts an energy of 400 tons. In other words, the energy exerted is nearly twice as great as that shown by a 2,000 pound shot fired from 100-ton Armstrong Gun." The above brief study in dynamics was extracted from the Portland, Me., *Evening Express*, I inclose it as another instance of how reliable the information on such subjects is in the average daily paper. Trusting it may serve to edify or amuse the readers of the American Machinist. What do you think of it? *A.*—We think very little of it. In the first place we do not see how we can comply with the suggestion of sitting down and figure on the subject when the weight of the train is not given, neither is the velocity of the shot given. Again energy, or kinetic energy, is not measured in tons or pounds, it is measured in foot tons, or foot-pounds, it is the work a body can do before it is brought to rest. The kinetic energy is found by dividing the weight of the body, or the weight of the train, in this instance, by 64.4, and multiplying the quotient by the square of the velocity in feet per second at the instant the collision occurs. If we assume the weight of the train to be 200 tons, and moving at the rate of 110 feet per second, its kinetic energy will be

$$\frac{200 \times 110^2}{64.4} = 37,577 \text{ foot-tons},$$

and before the train can be brought to rest that amount of energy must be taken out of it. If we assume that the velocity of the cannon ball is 2,000 feet per second at instant it strikes a body, and the weight of the ball is one ton as stated, then its kinetic energy will be

$$\frac{1 \times 2\,000^2}{64.4} = 62,111 \text{ foot tons},$$

and the ball will not come to rest until this amount of energy is taken out of it. From this it appears that the reporter made a serious mistake in his figures or did not figure at all.

(197) W. Y. S., ——, asks: How can a reamer or arbor be straightened after hardening? *A.*—Heat as hot as possible without drawing the temper too low, and straighten while hot, a screw-press being safest for the operation. 2. What effect will soap, either hard or soft, have on tools, such as taps, reamers or milling tools? *A.*—Supposing you mean during the hardening operation, soap seems to tend to keep the articles bright and clean during the heating. 3. How does Jessop's steel compare with Hobson's for tools, especially taps and milling tools? *A.*—We do not know. Both are good steels, and if the makers of either furnish a bar of steel knowing that it is to be used for taps or for milling cutters, it will probably be satisfactory, and the same can be said for a number of other brands of steel, both foreign and American. 4. Can you recommend a book that will give me hints on hardening and tempering? *A.*—We know of nothing better than "Condensed Suggestions to Steel Workers," published by Miller, Metcalf & Parkin, Pittsburgh, Pa. 5. Please inform me how to anneal cast-steel forgings and have them soft? *A.*—Heat them carefully, evenly and to a dull red heat. Then cool them slowly; as in hot ashes. 6. I have a great many dies to harden. They are used for drawing hard spring steel cold. I quench them in water, but they don't stand the work as well as I think they should. Can you help me out in any way? *A.*—The probability is that the best plan is to consult with the maker of the steel used for these dies. Let him furnish steel specially for them and suggest the treatment for it. Any steel-maker who is really trying to make steel that will be satisfactory to his customers will gladly correspond about such cases, and will take pains to furnish a specially adapted steel, if possible. 7. I would like to purchase a book that would enlighten me both in the making and handling of steel. Can you inform me where I can obtain such a book? *A.*—"Appleton's Cyclopedia of Applied Mechanics," treats of making and handling steel, and Vols. II., III. and IV. of "Practical Blacksmithing," treat on its working. The latter is published by M. T. Richardson, New York. "The Metallurgy of Steel," by H. M. Howe (published by the Scientific Publishing Company, 27 Park place, New York), is the most complete and modern work on steel making and working, but is not, generally speaking, well adapted to the needs of the practical steel worker, either in character or price.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Speed Gage McLauthlin & Co., Fulton St, Boston.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N.J.

M. E. Howard, Indianapolis, Ind. Specialty, 4 and 8 H. P. engines in stock, write for price.

Engine Castings, 1 to 6 Horse-power Vertical. Humphrey's Foundry, Bellefontaine, O.

Sheet metal tools & light mach'y, imp'd, cheapened & mfg'd. Prac. Mach. Co., Bridgeton, N. J.

American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

Magneto Hand Telephone—Hughes; post free, $1. Lists free. Spon & Chamberlain, 12 Cortlandt street, New York.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co. New York, N. Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

An English writer describes a fast engine being built at Wolverhampton as having 12-foot wheels and a *thirty minute* stroke. This is only equaled by the American engineer who described a bogy engine as having "a three months' lap."—*Locomotive Engineering.*

Or by the man in somewhat earlier days in railroading when engineers were more

generally than at present expected to give a brother chip a ride over the road. In the instance referred to a fellow had fairly convinced the engineer of a train that he was all right, having run on a Western road, and had got fairly located for a hundred mile trip. Now it happened that the engineer of this train was rather intensely interested in valve motion, and never missed an opportunity to discuss general practice in regard to lap, lead, etc. Here was his opportunity. "How much lead," he inquired of his deadhead passenger, "do they give the valves on your road?" After considerable mental effort the reply was, "Well, about three feet."

Profit-sharing.

AN OPEN LETTER TO EMPLOYERS AND EMPLOYES.

In anticipation of a revival of business and the consequent re-opening of many mills and factories, which now seems probable, we would invite your attention to the importance of introducing some form of profit-sharing as a feature of your industrial relationships. The method of paying a dividend to the workman out of profits as they are realized annually has been approved by most of the economists of Europe and America as thoroughly practical, and advantageous to both the employer and the employed. We will mention a few characteristics which should commend it to your careful attention.

Profit-sharing can be adopted by an employer without risk of loss, inasmuch as he assumes under it no obligations except such as are to be discharged from profits actually made. His prerogatives as manager and his rights as proprietor are not curtailed. Profit-sharing would establish a more friendly relationship of common interest between working people and the employer. This would be the surest pledge of industrial peace and the firmest support in times of commercial distress.

The employe, responding to such an advance by the employer, can increase the quantity and improve the quality of the product under a deeper feeling of personal interest. By his diligence, care and economy he can actually create an additional profit, which is to be used in supplementing regular wages. Profit-sharing includes the payment of the best wages current, and promises a bonus beyond this, which, experience shows, the interested workman can invariably produce in good times.

Profit-sharing, as a principle, may be applied in a large variety of ways; and it can readily be adapted to the great majority of productive and distributive enterprises. We invite applications for full information concerning the history and the results of the system, as it is now in operation in many establishments, small and large, in Europe and the United States. The address of the secretary of our association is No. 25 Beacon street, Boston, Mass.

For the Association for the Promotion of Profit-sharing:

Carroll D. Wright, Washington, president; Francis A. Walker, Boston, N. O. Nelson, St. Louis, vice-presidents; N. P. Gilman, Boston, secretary; R. Fulton Cutting, New York, Alfred Dolge, New York, R. R. Bowker, New York, Henry R. Towne, Stamford, Conn., George A. Chace, Fall River, Mass., directors.

Crucible Furnace for Burning Petroleum.*

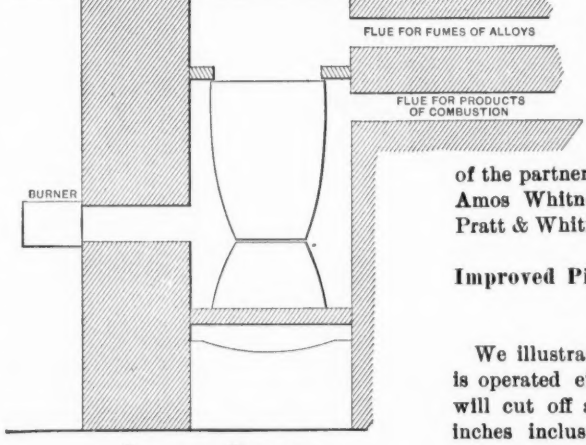
By W. E. Crane, Waterbury, Conn.

The furnace is built round as high as the top of the crucible, and four or five inches larger in diameter. From there up it is built square, and the corners used as described further on.

The pot stands on a support about six inches high. If it is a furnace running continually, it is immaterial of what substance it is made, or how solid, provided it will withstand the high temperature.

If a furnace runs 10 to 12 hours only per day it should be made with as little substance as will withstand the temperature and weight. If made solid, the first heat will take longer, as this support must be thoroughly heated through before the bottom of the pot will heat. After the first heat any support will be all right. Fig. 1 shows an elevation of the furnace, which has been rebuilt from one using grates for coal. A brick bottom is put over the grates to preserve them, but one grate should be taken out and a hole left through the bottom, so that the metal can run through if a pot breaks.

Fig. 2 shows a plan of furnace at the top of the pot. Four pieces should be provided of the shape shown in one of these corners, which will rest on top of the pot and in the corner of the furnace, shutting in the products of combustion around the pot below the top. By this means fully 15 per cent.



Crucible Furnace.

of the fuel will be saved, a much hotter fire secured, and faster work done. A small flue should lead off from the top of this chamber, not over 2½ inches square, either to the chimney, or to a heater for heating the air, or to other system of economizing the heat from waste gases.

When the waste heat is utilized, this construction is essential in melting alloys, especially where spelter or zinc is used, as the fumes would coat over or fill up any economizer. By closing the space at the top of the pot the fumes from the alloys can be carried off through a separate flue. This flue should have from 30 inches to 40 inches area.

The burner would preferably be an air burner, with as low a pressure as possible. Some burners work nicely with as low as 6 ounce pressure. All of the air for combustion should be supplied by the blower. With an air burner at high temperatures there is usually a deposit of carbon. This can be prevented by introducing a small jet of steam, preferably superheated. As a general thing this will be found to cause more annoyance than that of removing the deposited carbon. The steam will have a tendency to lengthen the flame, and as a consequence the heat will be less intense, more of the heat passing off into the flue.

There should be a good draught to take off fumes when using alloys, which smoke a good deal; but the draught for the products of combustion should be light.

For the support for the crucible in furnaces running ten hours per day I have found an old pot cut off at the right length and turned bottom up to be as good as anything tried.

The pieces to shut off at the top of the pot should be made of crucible stock and well seasoned.

In reply to inquiries the author said that the life of crucibles used in this furnace was on the average 35 heats for brass and 15 heats for German silver. The welding on of the covers was prevented by the use of black lead, and the oil pipes were readily cleaned when necessary by steam.

* Presented at the New York meeting, December, 1893, of the American Society of Mechanical Engineers.

Death of George S. Lincoln.

Mr. George S. Lincoln, who for many years was at the head of the Phœnix Iron Works, of Hartford, died recently in that city at the age of 75 years.

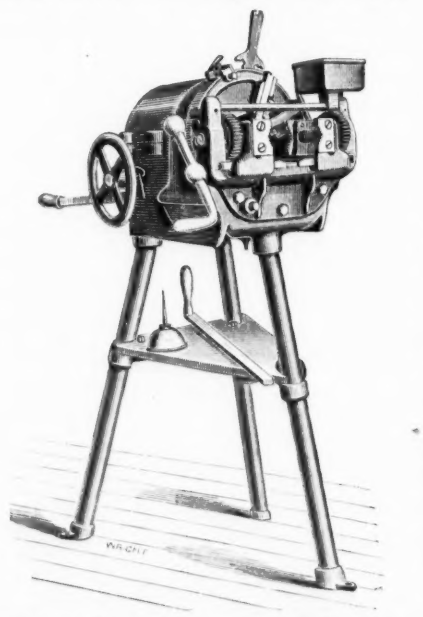
Mr. Lincoln is perhaps best known to the mechanical world through the circumstance of his having given his name to that type of milling machine known as the "Lincoln Miller"; a machine designed by Mr. F. A. Pratt, while superintendent of the Phœnix Iron Works; then (1853) Geo. S. Lincoln & Co. Of this machine, probably more than 50,000 have been built by various makers, and it has exerted a very important influence upon the modern development of interchangeable manufacture.

Mr. Pratt, in speaking of the death of Mr. Lincoln, said: "George S. Lincoln was an excellent man in all respects, and in my long service with him (nearly ten years) I do not recollect of there having been between us anything but the most friendly relations."

Mr. Lincoln was a man who could be implicitly trusted, a man of good judgment, but perhaps rather too cautious and conservative to take full advantage of opportunities for development; this, it is understood, having been the main cause of the formation of the partnership between F. A. Pratt and Amos Whitney, and the founding of the Pratt & Whitney Company.

Improved Pipe Threading and Cutting-off Machine.

We illustrate herewith a machine which is operated either by hand or power, and will cut off and thread pipe from 1 to 3 inches inclusive. It is so designed that when cutting off pipe, the dies are opened for the pipe to pass through without being removed from the machine. This is accomplished by a simple movement of the lever operating the cams. The gears and bearings are inclosed in an oil chamber, and are thus protected from chips or dirt which



Improved Pipe Threading and Cutting-off Machine.

might otherwise get into the working parts, while the bearings are at the same time kept constantly lubricated.

There are several new features in this machine. The gripping vise is detachable, and can therefore be readily replaced, being bolted to the bed of the machine. More room is given in the receptacle for cuttings, and the travel of the die head is increased, thus permitting the cutting of a longer thread than usual, if desired, and giving greater ease in using the machine, since there is more room in setting the dies or removing them from the die head.

The vise is also enlarged, admitting of the use of nipple holders for 3-inch pipe, that being the full threading capacity of the machine.

The machine is furnished with countershaft when power is to be used for driving, and weighs, when for power, 250 pounds, for hand, 225 pounds. It is manufactured by the Armstrong Manufacturing Company, of Bridgeport, Conn.

A recent disastrous explosion in the Ramapo Iron Works calls attention to the fact that it is too little understood among furnace men and blacksmiths that, when green coal is on the fires, and the fan or blower is stopped for any reason, the gas from the coal is liable to enter the blast pipes, and, mixed with the proper proportion of air, form an explosive which, when fired, will wreck the blast pipes, and possibly the building, as is stated to have been the case in the instance referred to above.

When the blast stops for any reason, the valves should be closed to prevent a possible return of gas.

A good deal of stir is made by some of the daily papers commendatory of the fact that Postmaster Dayton, of New York, has actually saved some dollars—the amount named we do not believe for a minute—by cutting off the privilege of the employes warming their coffee over the gas jets. But while we have the "abiding faith" of the late Horace Greeley that the amount stated as saved has, in effect, been multiplied by some figure, and then multiplied again so as to make a sum of respectable roundness, there is still no doubt that the privilege those operatives—workmen—enjoyed cost each inhabitant of the country a fraction of a cent every year—a fraction that must find its expression somewhere among the infinitesimals of the mathematician, but still a fraction. Every dollar the big fellow in the political ring steals is legitimate plunder, but when it comes down to a poor devil's warming his coffee, there is a chance for saving that cannot be omitted. There is a lot to talk about in it. Cutting off big losses through bad management is likely to hurt somebody with a "pull." Making it a little more uncomfortable and unpleasant for the fellows who do the work will not create the slightest political ripple—not now, but, perhaps, some time.

A Mean Swindle.

TWO PROMINENT CITIZENS OF SIGOURNEY, IOWA, UNDER ARREST.

Sigourney, Iowa, Jan. 5th.—Post Office Inspector Mercer yesterday arrested B. H. Wills and William A. Bell, both prominent citizens, and managers of State patent investment companies. The arrest caused a sensation, as both men have been for years transacting a big business. The plan of the concerns was to watch the daily papers and get a list of patents granted. The victim was informed that he could trade his right for a farm, but it would cost $40 to look up the title. The money was sent, and then, in due time, the victim was advised not to make the trade, as the land was heavily encumbered.—*Boston Daily Journal.*

Editor American Machinist:

The only remedy is to teach the possible victims that there is not one chance in a thousand that an offer from a patent selling concern is anything whatever but an introduction to a "mean swindle," as mean as or meaner than the above.

It appears that "both men have been for years transacting a big business," and in truth the business is a large and prosperous one, the first and principal partner being the United States Government. The government paves the way, gives the opportunity, refuses to afford the victim simple and cheap means of information, and then sends a Post Office Inspector to arrest the swindler and fine him a part of his booty. The crop of patents issued each week is about five hundred, and not half of them are for genuine inventions. The bulk are for mere contrivances of lawyers, amateurs,

farmers, ladies, boys, and unmechanical people of all sorts, and are not worth a copper each.

Take a sample case, not an imaginary but a real and frequent case, and follow it through. A brakeman invents a car coupler, but, as every brakeman in the country has invented a car coupler, the subject is worn thin and there is nothing new to be had in that line. It is easy enough to contrive some new quirk, to add a dingus above or a wingwang underneath, but not one patent a year shows an item of the smallest value. Of course, the brakeman applies for a patent, and, of course, he employs one of the "no patent, no pay" solicitors, whose business it is to forge gimcracks into such formal shape that some sort of a patent can be worked over each case. He gets some sort of a patent on the car coupler, good or bad, but it has a red seal and a blue ribbon, and it is all the same to the brakeman. The shyster—and I use that term with care—cannot fail to get a patent on anything presented, he secures his share of the booty, drops the matter, and things are ripe and ready for the third partner—the patent-selling shark. The government has undoubtedly notified the solicitor that there is not the ghost of a shade of difference between the car coupler and dozens of others already patented, but it does not require even that difference to secure a patent. The brakeman never hears of it because the business is entirely between the government and the solicitor, and such a thing as informing the inventor of the true position of his contrivance is not thought of. The government acts on the cheap fiction that the solicitor is representing the inventor, while he, in fact, is simply beating him.

The shark has various methods, changing his game as fast as found out; and this title-examining dodge is as good as any. It is thoroughly hidden, very simple, apparently very honest, and quite safe. The shark sends out his circulars, and the brakeman, after writing a dozen unanswered letters to railroads and car-manufacturing companies, is tempted to see what he can do through him. A little correspondence follows, and he receives a statement that the patent can be exchanged for a certain farm. Brakeman is not at all astonished at the offer of a farm for his invention, had expected more than that, and tells the shark to go ahead. Shark then writes the brakeman that it is wise to have the title of the land examined, at an advance fee of forty dollars, and the trick often works and yields the shark a "big business."

The government has beat the brakeman $35, the solicitor $50, the shark $40; all shake hands and proceed to do up the next inventor.

George B. Grant.

Laying out Patterns for a Blast Pipe.

By Geo. Guntz.

At one time I had a job of fitting up a blast pipe for a cupola. The blast pipe was 24 inches in diameter and came up from underground connecting to the wind gate by a tapering curved elbow tapering from 24 inches down to 15½ inches, where it fitted into the collar of the wind gate on one side, while the elbow here illustrated was a continuation of the blast pipe being fitted to the other side of the wind gate, the collars of which were round, 15½ inches in diameter, and to the collar on the belly pipe, which was oblong with round ends, outside dimensions of which were 13x23 inches. I had only 20 inches from the face of the wind gate to the side of the cupola, and a vertical height of 14 inches from the center of the wind gate down to the belly pipe. These were rather close quarters to work in, so I determined on a square throat, as here shown, in order not to make the taper too abrupt. In the illustration, Fig. 1 is a side elevation, Fig. 2 an end elevation, Fig. 3 is a plan of the oblong end *d b*, Fig. 1, and a half plan of the first joint *e g*, Fig. 1. Fig. 4 is a half plan and elevation of the first and second joints *e g*, *n k*, Fig. 1, and in Fig. 9 is also shown the third joint *n o* in relation to the round end.

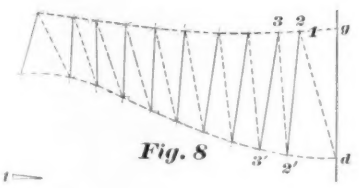


Fig. 8

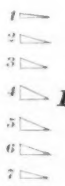


Fig. 7

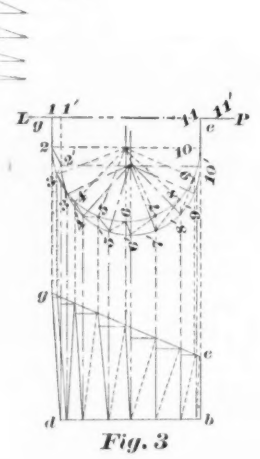


Fig. 3

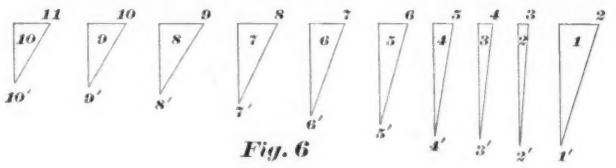


Fig. 6

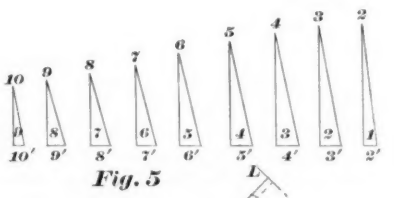


Fig. 5

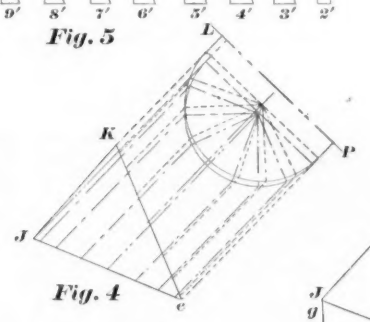


Fig. 4

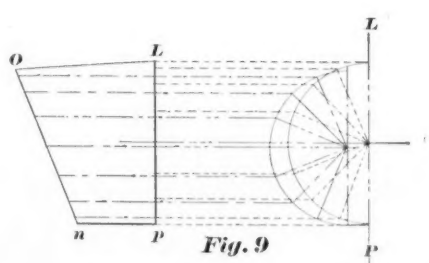


Fig. 9

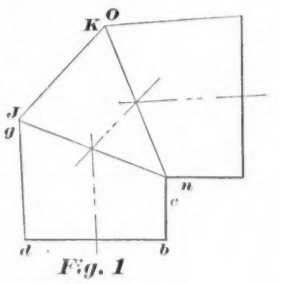


Fig. 1

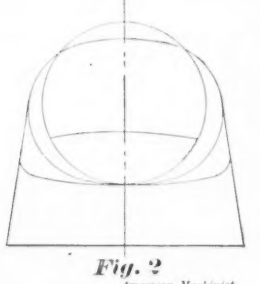


Fig. 2

American Machinist

Laying out Pattern for a Blast Pipe.

In developing a pattern for an article of this kind, while it can be done by the intersection of oblique cones, it is not always feasible, because the convergence of the lines to the apex of the cone are, in the majority of cases, so slight that the height of the cone will become too great for the available room, or, having the room, there would not be the necessary facilities with which to strike the radii. Therefore the following method commends itself, and also for the reason that it is not necessary that the different sections through the joints should be exact conic sections. In Fig. 8 is shown the pattern of the oblong section *g d b e*, it was obtained as follows: The base and the first joint, Fig. 3, were each divided into spaces as equal divisions of a half circle, and made with 45 degree and 22½ degree triangles from the center of each circle, as shown by the radial lines. This brought the points 2, 3, 4, 5 and 2′, 3′, 4′, 5′, in exact relation to each other on the different ends of the pieces. These points would then be dropped down on the base and the first joint from their respective places, and lines were then drawn from those on the base to the corresponding points on the first joint. Since it was necessary to determine the altitude of the points on the first joint above the corresponding ones on the base it was found easier to keep their relation in view by having them connected by a line, and for this reason also the diagonal dotted lines were drawn across the spaces formed by the solid lines. The points between the two sections on the plan were also connected with lines for the same reasons. It will be noticed that at first joint, Fig. 1, there are small triangles made by each of the spaces made by the solid lines and of which the miter or joint line is the hypothenuse. The object of these will be explained further on.

It is proper to say that the sections in Fig. 4 were spaced off as explained above, and the points dropped on to the elevation, as were also those in Fig. 9, but the operation of connecting the relative points with the solid and dotted lines and of forming the small triangles were dispensed with as not being essential here as the method of determining the pattern of each piece is the same. It will also be noticed that in the spacing of the sections in Fig. 9, on the oblong section there are ten spaces, while on the circle there are only eight. This comes from the fact that while the center of the circle is directly at the junction of the transverse and conjugate center lines, the centers from which the end circles of the oblongs are described are on the conjugate center line, but not on the transverse, so if we divide the circle in the same manner as we have the end circles of the oblong sections we can get only eight spaces, while in the oblongs we have the same eight and two more formed by drawing a line through the center from which these circles are struck parallel to the transverse center line. This, however, is regular in coming from an oblong or an ellipse into a round, and will work itself out in the same way. Having determined all the points as above stated, the next step in the process was to construct three sets of triangles, Figs. 5, 6 and 7. Of those in Fig. 5 the verticals represent the height of the corresponding points on the joint or miter line *e g* above those on the base *a b*, which are connected by the solid lines, Fig. 3. The horizontals represent the distances between the corresponding points of the two sections on the plan, Fig. 3, as 2 and 2′, 3 and 3′, 4 and 4′, etc. The hypothenuses of these triangles represent the exact length of the solid lines on the elevation which connect the points on the base and miter lines. Of those in Fig. 6 the verticals represent the vertical distance between the points connected by the diagonal dotted lines on the elevation. The horizontals represent the length of the dotted lines in Fig. 3, connecting the points, as 1′ 2, 2′ 3, 3′ 4, 4′ 5, etc., and the hypothenuse the length of the diagonal dotted lines in the elevation. Those in Fig. 7 represent the small triangles shown in the elevation, Fig. 3, and are constructed as follows: The verticals are taken from the elevation and represent the height of one point above another on the slant of the miter line, the horizontals are taken from the plan on the section of the miter, and are successively the distances from one point to another on the curve as from 1 to 2, 2 to 3, 3 to 4, etc., and the hypothenuses represent the length of these distances up the slant of the miter from one point to the next. Having constructed these triangles the development of the pattern, Fig. 8, is the next step. It may be well to say here that the hypothenuses of the triangles are the actual construction lines of the pattern since they are the actual distance between the corresponding points on the two ends of a section, the length of which it is possible to obtain only in this way, as their actual length cannot be shown on either plan, elevation or section since they all stand in perspective. Now, to develop the pattern, Fig. 8, I draw a line *d g*, Fig. 8. On this line set off the length of the line *d g*, Fig. 3. Since this line is not in perspective its actual length can be taken directly from the elevation. This is also a fact with regards to the line *b c*. Having set off this as above, I next took the distance 1′ 2′, Fig. 3, and set it off from the point *d* on one side of the line *d g* by describing an arc as 2′. I next took the hypothenuse 1′ 2 of the triangle 1, Fig. 6, and using *d*, Fig. 8, as a center, I described arc 1, and with the hypothenuse of triangle 1, Fig. 7, I set off the distance *g* 2, Fig. 8, cutting the arc made by the previous operation establishing the point 2; then with the hypothenuse 1′ 2 of the triangle 1, Fig. 5, as radius and point 2 as center, I cut the curve 2′, thus producing the section *g* 2 2′ *d*; then with a radius 2′ 3′, Fig. 3, with 2′, Fig. 8, as center, another arc 3′ was described, and with the hypothenuse of triangle 2, Fig. 7, and with 2, Fig. 8, as center, the arc 3 was described, and with the hypothenuse of 2′ 3 of triangle 2, Fig. 6, and 2′, Fig. 8, as a center, the arc 3 was cut establishing a point 3, and with the hypothenuse 3 3 of triangle 2, Fig. 5, and with the point 3, Fig. 8, as a center, the arc 3′ was cut, completing the second section, and this was continued successively until the pattern was complete. The patterns for the other two pieces were cut in the same manner, only that for the middle piece it was necessary to make two sets of triangles generated as those in Fig. 7, one for each end of the piece, thus making four sets for this piece.

A Novel Time-glass.

"During a trip which I took through the West Indies several years ago," said a traveler, "I saw a sight in one of the villages which brought the old proverb, 'Necessity is the mother of invention,' forcibly to my mind. In the front of one of the houses on a veranda stood a sentry whose business it was to keep the time for the village by means of a primitive sand-glass. Two beer bottles were firmly tied together, mouth to mouth, and fixed in a wooden frame, made to stand in reversible positions. A quantity of black sand ran from one bottle into the other in just half an hour, and when the upper bottle was empty the frame was reversed. Twelve short sticks marked with notches from one to twelve were hung upon a string, and a hook was placed between the stick bearing the number of notches corresponding to the hour last struck and the one to be struck next. The sentry announced the time by striking the hours on a large gong."—*St. Louis Globe-Democrat.*

The annual convention of the National Association for the Advancement of Science is to be held in Brooklyn in August.

A great deal of money is being thrown away for fees for useless patents simply because of the too prevalent notion that a patent is a patent and will prevent any one but the patentee from making or selling the thing patented.

Mechanics should remember that there is as much difference between patents as re-

gards the quality of them as there is between horses, or houses, or dogs, and that if an inventor or his attorney is not particular as to what kind of a patent he obtains, it is very easy to obtain something from the Patent Office which has the general form of a patent—has the fine steel engraving on the front above the red seal and blue ribbon, but which is nevertheless not worth a single cent.

Thousands of such patents are being taken out, especially upon the "no-cure-no-pay" principle.

If a thing is worth patenting at all—which it generally isn't—it is worth patenting right, and a patent properly taken out, and where the attorney really studies the interest of his client and does the best possible for him represents an amount of work very well worth the amount charged—work which has to be done in any event whether it turns out that a good patent can be obtained or not.

This is work which should be paid for in any event, whether a good patent is finally found to be obtainable or not, and where it is not to be paid for unless a patent is obtained, the question will naturally arise as to what value there may be in a patent obtained under such circumstances.

There are many shysters who are writing patent applications and getting money for doing work which would be much better left undone, and the biggest shyster can often get up the most attractive circulars, pamphlets, etc.

An accident which occurred to a locomotive in New England, recently, is attracting considerable attention, but its most remarkable feature seems to have been overlooked. The engine was pulling an express train, and when within five miles of Stamford, and running at full speed, a cylinder-head blew out. The train, however, did not slacken speed and ran into Stamford on time. It is stated that the train's momentum carried it the five miles at full speed, though, of course, we all know there must have been a considerable down grade to help along.

The surprising part of the incident to us, however, is that the air-brakes did not stop the train by the "emergency clause." It is probable, of course, that steam was being used when the head blew out, and, we believe, that in nearly every instance an engineer would instantly, under such circumstances, shut off steam and apply the brakes—automatically, so to speak, and without stopping to think whether it were the best thing to do or not. When anything out of the usual order happens to a lathe or planer, the first thing the machinist does is to dive for the shipper and stop the machine. His doing this is not the result of consideration at the instant, but of previous training, and he may be expected to do this in spite of himself, if we suppose he could wish not to do it. An engineer's throttle lever and brake valve are handled in an emergency on the same principle and absolutely without thinking and without time to think.

On the Wyoming "Flyer."

A man was one day making a trip on the "flyer" of a Wyoming railroad. Passage on these trains is never taken except for journeys of considerable length; walking is as easy and much safer for short distances. On this occasion the movement was even more deliberate than usual, and the passenger called the conductor to his seat and said:

"Isn't this motion pretty slow?"

"Well, we ain't flying, I admit."

"May I ask what is the trouble, then?"

"Certainly. We found a fine two year old steer stuck in a trestle back here before you got on and stopped and helped it out. You know the rules of the road are in such cases the animal belongs to the company."

"But I don't see why that should make you run so slow."

"Why, we're taking that steer to head quarters, got it tied behind, and it ain't used to leadin', and don't walk up very well. I'm doin' all I can—got the brakeman prodding it up with an umbrel', and an ear of corn tied to the end of the bell-rope. If you think I'm going to start up and go howlin' along, and yank the horns off as good a steer as there is in this State, why, you're mistaken, that's all!"—*Converse County* (Wyo.) *Press.*

MANUFACTURES

E. R. Latta will establish a planing-mill plant at Huntsville, Ala.

The Phœnix Iron Works, Phœnixville, Pa., are running night and day.

M. M. Irwin & Son will erect a sash and blind factory at Marysville, Tenn.

It is reported that an electric light plant will be established at Van Alstyne, Tex.

The Sunny South Lumber Company will rebuild its burned plant at Texarkana, Ark.

The Waycross (Ga.) Lumber Company will at once rebuild its recently burned mill.

William Dunham and others have started up their new shingle-mill at Charleston, S. C.

J. L. Donovan has purchased and will rebuild the Lampasas (Tex.) electric light plant.

Snyder Sons & Co. will establish a wool-working factory at Piqua, O., at a cost of $100,000.

W. B. Hutchinson, of Michigan City, Ind., will build a large lumber plant at Cordele, Ga.

R. L. Fox is interested in a project to establish an electric-lighting plant at Edgefield, S. C.

A municipal electric light and water-works system will be established at Demopolis, Ala.

The Spang Steel and Iron Co., of Etna, Pa., has started its blooming, bar and Clapp Griffiths mill.

H. W. Sexton, J. C. Keith and others contemplate erecting a cotton mill plant at Anniston, Ala.

The Central Manufacturing Company will enlarge its wood working plant at Chattanooga, Tex.

The Western Coal and Mining Company is erecting a power house near its mines at Jenny Lind, Ark.

H. Kohlhorst will organize a company to manufacture doors, frames, furniture, etc., at Terra Alta, W. Va.

W. H. Glover is interested in the formation of a company to establish an electric-light plant at Terra Alta, W. Va.

The newly organized Texas Manufacturing Company will establish a wood-working factory at Fort Worth.

The Dayton Coal and Iron Co., Dayton, Tenn., has blown in one of its furnaces after a temporary shut down.

The Belcher & Taylor Tool Co., Chicopee, Mass., have begun to run on full time and with a full number of hands.

At the works of the Pennsylvania Steel Co., at Steelton, Pa., it is expected to have the entire plant in operation soon.

We are informed that the Ellwood Shafting and Tube Co., of Ellwood City, Pa., will soon be operated night and day.

The South Chicago plant of the Illinois Steel Company started up on March 19th after a six-months' shut-down.

At Abbeville, S. C., the Greenville & Columbia Railroad is adding $30,000 worth of new machinery to its machine shops.

The Ansonia Electric Co.'s plant is being operated on a schedule of eight hours a day with a fair number of employes.

The Canonsburg (Pa.) Iron and Steel Co. will erect an addition to its plant, 75x100 feet, to be built entirely of iron.

Shoshone Falls, Snake River, in Idaho, may be harnessed to generate electricity to operate an electric-railway system.

In Abbeville, N. C., W. P. Beard and J. C. Klogh have incorporated the Tugaloo Iron Works, with a capital stock of $12,000.

The Raleigh Spring Bed Co. has built a new factory at Wake Forest, N. C., and will at once remove its machinery into it.

The Round Mountain (Ala.) furnace will resume after a long idleness. Two idle furnaces at Sheffield are also preparing to start.

KEY TO ENGINEERING. (ENLARGED.)

We have published a new edition of our book **KEY TO ENGINEERING**, which contains part three, the whole making a book of 174 pages, bound in imitation leather. Following are the subjects treated on in the additional chapters:

THE THREE STATES OF WATER.

Vaporization; What is Vapor? Heat Units; Vapor Atoms.
Vapor; An Elastic Fluid. Ebullition and Circulation.
Heat and Expansion of Water. Vapor in Water, Air and Steam.
Evaporation—Escape of Vapor. Condensation. On the Vacuum.

ELECTRICITY.

Technical Terms. Parts of the Dynamo.

MISCELLANEOUS TABLES.

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All gears accurately cut. All feeds positive.
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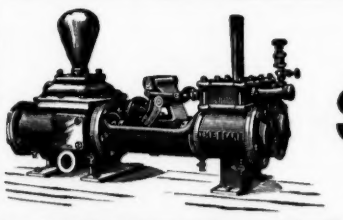

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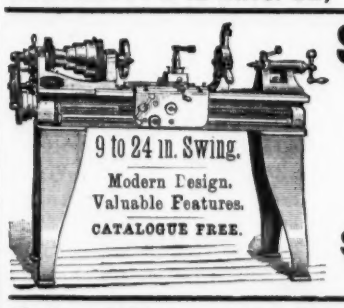

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87 MAIDEN LANE, N. Y. Jersey City. Chicago. Philadelphia. Boston. London

W. & B. Douglass, pump manufacturers, Middletown, N. Y., have increased their working force and will be shortly running on full time.

H. C. Sparhawk is one of a committee which will arrange for the establishment of a $60,000 electric light plant at Marblehead, Mass.

The Peck, Stow & Wilcox Co., at Southington, Conn., has under consideration plans for the construction of a new malleable iron foundry and a new gray iron foundry.

Orr & Sunblower, Reading, Pa., issue a catalogue of the great variety of engines and boilers they build for almost every purpose. Their catalogue is a good one to have.

Chandler & Taylor, Indianapolis, Ind., are putting in one of their 65 horse-power engines of the latest design for the Laycock Manufacturing Company, the works requiring more power.

George H. Talbot has commenced to rebuild his burned wool-scouring mill at Norton, Mass. The new plant will cost in the neighborhood of $75,000, and will afford employment to about 75 men.

It is reported that the Slatersville (Mass.) Cotton Company will erect a new building to contain 1,000 additional looms, in the spring. This will increase the producing capacity of the plant about one-fourth.

At a recent meeting of the Pacific Rolling-mill Company, of San Francisco, Cal., James G. Fair was elected president; W. P. Sullivan, Jr., secretary; C. M. Keeney, general manager, and P. Noble, superintendent.

The Illinois Steel Company, whose plant at South Chicago has been idle since early in September last, has started up. The officials say they have orders for sufficient rails to keep them employed for at least sixty days.

The Farrel Foundry and Machine Co. say that business is increasing in their machinery departments, though the roll departments are working under the old conditions. Better prospects are in sight though prices remain low.

The Laycock Manufacturing Company, Indianapolis, Ind., is running full time and now has 126 men employed, against 90 men in March, 1893. Mr. Laycock says the company's business the last 30 days has been a genuine surprise.

The Sinker-Davis Machine Works, Indianapolis, Ind., are running full time and full handed. The company has been very fortunate in securing a contract for a considerable number of garbage crematories on which there is a good deal of work.

The Andover (Me.) Steam-mill Company has been organized at Andover for the purpose of manufacturing, buying and selling wood and lumber of all kinds, with $10,000 capital stock. The officers are: President, R. A. Grover, of Andover; treasurer, R. L. Melcher, of Andover.

Foreign orders are plenty now with J. A. Fay & Co., of Cincinnati, Ohio. A big one has just come to them from Havana, Cuba. It will take three months to execute it, comprising as it does an outfit for furniture making, wagon and car building, with a planing-mill equipment in addition.

The Cincinnati, Georgetown & Portsmouth R. R. are now building new shops at Columbia, Ohio, and have closed a contract with The Lodge & Davis Machine Tool Co., of Cincinnati, O., for the entire equipment of machinery, including boilers, engine, planers, lathes, drill presses, shapers, etc.

Judge Wheeler has granted an order of sale of the plant of the Branford (Conn.) Lock Works. The order provides that the plant shall be sold in its entirety at public auction at the offices of the company, Branford, on April 14th. The minimum sum of $81,000 is named as the smallest amount which would cover the liabilities. It is probable that the firm of Yale & Towne, of Stamford, will purchase the plant.

The Cleveland Twist Drill Co., Cleveland, O., write us: Our grip sockets are selling faster than we can make them. We have just furnished the U. S. Government at its Washington Navy Yard six of each size from No. 1 to No. 5 inclusive. As the navy officials never adopt a new thing without careful investigation, this order speaks well for the merits of our grip socket.

The Winchester Repeating Arms Company, at New Haven, Conn., is about to start on a lot of 100,000 rifles, which will keep the big factories in full operation for over a year. The weapon is to be called the "Winchester model, '94." The breech mechanism bears some resemblance to the model '86 rifle, but the new gun is widely different from this in several points of construction.

In the month of February the Parry Manufacturing Company, Indianapolis, Ind., shipped 2,939 four-wheeled vehicles, and in preparing them for shipment over 100,000 feet of rough lumber was used. Secretary Parry says that while they have not quite as many men on the pay-rolls as last March, the pay-rolls are larger, as the character of the work has been so improved that better skilled mechanics must be employed.

The Central Cycle Company, Indianapolis, Ind., is enlarging its plant, doubling its capacity. The building they now occupy is 100 feet long by 50 wide and three stories high. The new building will be of the same dimensions, extending westward over Pogue's run. This concern is unusually prosperous. The general manager states that two years ago they started up with 30 men. Last spring they got up to 90 men, and now they have employed 152 men.

Norton Bros. have just let the contract for their new tin can factory at Maywood, Ill. The building is of cream-colored brick, with dark trimmings, and will be a two-story structure, 250x275 feet. It will be quadrangular in form, facing on four streets, with power plant in the center, and its character will be what is known as "mill construction." The most approved heating and ventilating arrangements are contemplated. The building will be ready for occupancy July 1st.

The following explains itself: Sault Ste. Marie, Mich., April 2, 1894.—Having leased the shops of the Soo City Machine and Boiler Works at Sault Ste. Marie, Mich., for a term of years, the undersigned is now prepared to do a general line of machine and boiler work. Prompt attention given to all orders, and satisfaction guaranteed as to quality and prices. A full line of engines, boilers and general machinery furnished direct at manufacturers' lowest prices. Works on Union Dock. Respectfully soliciting a share of your patronage, I beg to remain, Yours respectfully, James A. Lawrie. Late Civil and Mechanical Engineer of the Solar Refining Co., Lima, O.

The Detroit Twist Drill Co. succeed to the business of the Graham Twist Drill and Chuck Co., with the following stockholders: Wm. Reid, Harry S. Hodge, Chas. M. Swift, and Nathan G. Williams, Jr., and all the above are directors. Wm. Reid, president; Harry S. Hodge, vice-president; N. G. Williams, Jr., secretary and treasurer, and general manager. The company has greater facilities than ever for carrying on the drill business, and are prepared to make all kindred tools. Henry F. Hiller continues as superintendent, and Donald Churchill will represent the company

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No.	INCH.	PRICE.	No.	INCH.	PRICE
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3	3/4	.50	9	2½	1.40
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6	1½	.85	12	4	1.90
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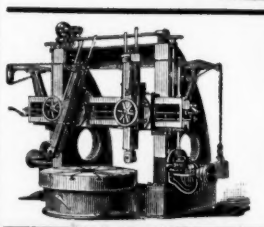
These goods are for sale by CHAS. CHURCHILL & CO., L'f'd, 21 Cross St., London, England.



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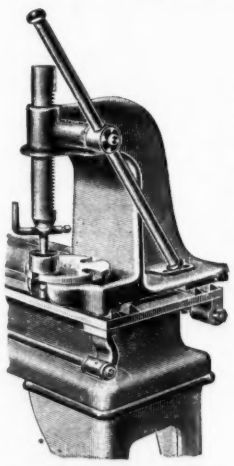

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Established a century ago.
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Screw Cutting Automatic Cross Feed, etc.
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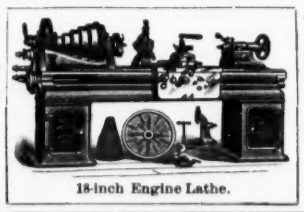
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SECOND-HAND CORLISS ENGINES.
150 and 300 H. P. for sale; also 100 and 200 H. P. Wheelock; Ball engines 25, 50, 75 and 125 H. P.; second-hand portable engines 6, 10 and 15 H. P.; also a large assortment of new portable and stationary steam engines with automatic or throttling governors; send for catalogue and quotations.
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IRON CASTINGS—CASTINGS FOR STEAM ENGINES.
The castings for the Geo. H. Corliss engines in the old days, then the castings for the Greene engines, now and for eight years the castings for the Armington & Sims Engines, should be marked "Builders Iron Foundry," if they showed the founders' name. Special attention always given to castings of this character. We also have built and are now in position to build special or experimental engines of any size.

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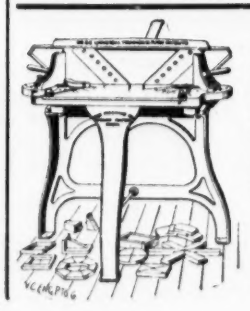

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Universal Trimmer
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HORSE POWER
ARE NOW IN USE.
SEND FOR SPECIAL PAMPHLET.
HENRY R. WORTHINGTON,
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among the manufacturers and dealers. The company write us that business is brisk.

Machinists' Supplies and Iron.

New York, April 14, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.75 to $13.50; No. 2, $12.00 to $12.50; Gray Forge, $11.25 to $12.00. Southern brands are quoted at $12 25 to $13.00 for No. 1 Foundry; $11.00 to $11.50 for No. 2, and $10.75 to $11.25 for No. 3.

Antimony—The market is dull and quiet. We quote L. X., 9¼c. to 9¾c.; Cookson's, 10c. to 10½c.; Hallett's, 8.65c. to 8.75c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 63c. to 63½c.

Copper—The market is practically unchanged. Lake Copper can be readily obtained at about 9.50c. The supply of Casting Copper is low, and is quoted at 9½c. to 9.30c.

Lead—The market is firm at about 3.45c., with the official bullion quotation unchanged at 3.30c. Supplies even at the higher prices are not very plentiful.

Spelter—The market seems to be demoralized; quotations are nominal at 3.70c. for New York delivery. There is no demand.

Tin—Sellers are disposed to be reserved in their offerings, as they claim that the outlook is in their favor. Prompt delivery can be obtained at 19.60c., and next month at 19.70c., but there is a scarcity of buyers.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

A prac. mech., 8 yrs. foreman, wants pos.; age 34, habits A 1. Foreman, American Machinist.

Wanted—Situation by experienced supt. Machinist and die maker. Address H., Am. Mach.

Wanted—Agents to sell our steel tapes. Timmis & Clissold, Bound Brook, N. J.

Wanted—Position as foundry foreman; will furnish reference. Address W. J., Am. Machinist.

Foreman patternmaker, of good geometric and constructive ability, desires a pos. R, Am. Mach.

Mech. eng., grad., experienced in steam engines and mach. tools, wishes pos. as draftsman for now or later. Moderate terms. Box 63, Am. Mach.

Wanted—Draftsman who has had exp. in mech'l heating and ventilating. State age, exp., refs., and salary wanted. Buffalo Forge Co., Buffalo, N. Y.

Wanted—Position as foreman in iron foundry, one familiar with all kinds of light and heavy castings in green, dry sand, and loam; references from last employer. P. H. Fox, Am. Machinist.

Wanted—A first-class mechanic, with necessary experience and ability to adapt him to successfully superintend construction of gas engines. Address "X. L.," care of American Machinist.

Mechanical engineer of large experience wishes position as superintendent, head draftsman or to travel for manufacturing concern, A1 reference. Box 55, American Machinist.

Young man desires position as assistant draftsman. Has taken course in drawing at technical school; 7 years' experience as machinist. Money not the first object. Box 62, Am. Machinist.

✢ MISCELLANEOUS WANTS ✢

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Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F A. Welles, Milwaukee, Wis.

Wanted—2d-hand 4 or 6 block wire-drawing bench, and two No. 4 Perkins' wire nail mach. in good condition. J. J. Gordon, Carleton, St. John, N. B.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

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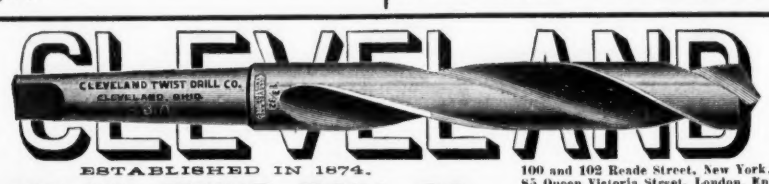

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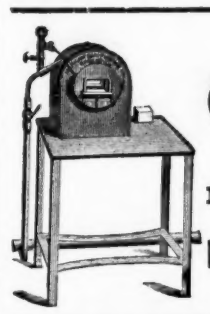

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For the economical generation and systematic application of HEAT.

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MODERN STYLE, IN GOOD ORDER
BEING THE EQUIPMENT OF A
MACHINE TOOL SHOP
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WILL BE SOLD LOW BEFORE REMOVAL.

IRON PLANERS.

19 in. x 3 ft. Wheeler.
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24 " x 5 " New Haven.
24 " x 6 " Wood Light.
26 " x 8 " Pease.
30 " x 6 " "
30 " x 10 " "
32 " x 6 " Wood Light.
36 " x 8 " Pease.
36 " x 16 " Bancroft.
36 " x 10 " Gleason.
60 " x 24 " Heavy Pattern.

SHAPERS.

6 in. Stroke, Crank.
8 " " Gould.
15 " " Hendey.
16 " " Gould & Eber.
22 " " Triple Geared.

SLOTTERS.

10 in. Stroke, Lowell.
12 " " Hewes & Phil.

DRILLS.

20 in. Swing, Prentice.
22 " " "
26 " " "
48 " " Old Style.
Radial Drill, 86 in.

BOLT CUTTERS.

3½ in. Complete, "Acme."
1½ " " National.

ENGINE LATHES.

12 in. x 6 ft. Reed.
13 " x 6 " Blaisdell.
14 " x 6 " Handey.
16 " x 6 " Blaisdell.
16 " x 6 " New Haven.
16 " x 8 " Ames.
18 " x 6 " Eddy.
18 " x 8 " Putnam.
20 " x 10 " Fitchburg.
22 " x 8 " Pease.
22 " x 12 " "
24 " x 12 " Putnam.
30 " x 10 " Pond.
32 " x 16 " Gleason.
36 " x 18 " Putnam.
84 " x 18 " Lincoln.
Pit Lathe, 72 in., F. Plate.

BOILER TOOLS.

Rolls, 6, 8 and 10 ft.
Punch, 36 in. Gap.
Shear, 30 " "
Flange Clamps.

MISCELLANEOUS.

Milling Mach. No. 2, "Cinti."
Milling Mach. No. 3, Garvin.
Bor and Turn. Mill, 38 in.
Vert. Turret Borer, B. & S.
Gear Cutter, 36 in.
Pulley Lathe, 36 in.
Screw Mach. No. 5, B. & S.

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E. P. BULLARD'S
N. Y. Mach'y Warerooms.

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NEW AND SECOND-HAND.

Plate Planer, 16½ ft., one setting. 1 in. Plate.
Shear No. 27, 30 in. throat, ¾ in. plate.
Above entirely New, made by Bement, Miles & Co.
Boiler Rolls, 8 ft. 3 in. between Housing. Cheap.
Punch, 21 in. throat. Teal.
57 in. Swing Driving Wheel Lathe, Double Head.

ENGINE LATHES.

100 inches x 20 feet.
74 " 24 "
51 " 18 "
48 " 16 "
40 " 14 "
25 " 24 and 16 feet.
24 " 25 feet.
Other Sizes.

Profiling Machine, P. & W.
No. 1 & 3 Universal Miller, B. & S.
1,500 Steam Hammer, Morgan.
200 Bradley " Upright.
Lot of Polishing Machines.
Shafting, Belting.

PLANERS.

72 inches x 25 feet. 4 Heads.
69 " 15 " 1 "
60 " 20 " 2 "
42 " 12 " 1 "
36 " 16 " 2 "
30 inches x 12 feet. 1 Head.
30 " 8 " 1 "
Smaller Sizes Planers.
9, 12, 14, 24 and 26 in. Shaper.
8, 12, 18 in. Slotter.
Drills, Radial and Post.
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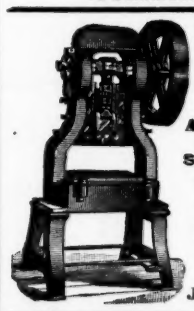

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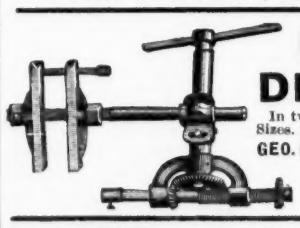

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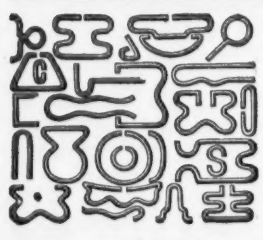

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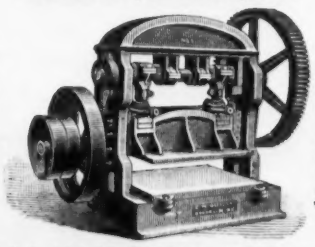

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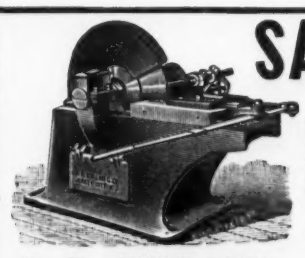

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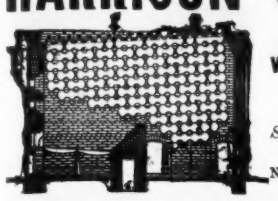

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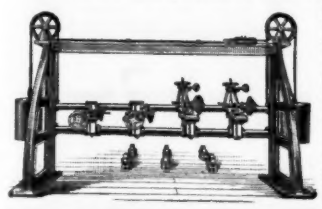

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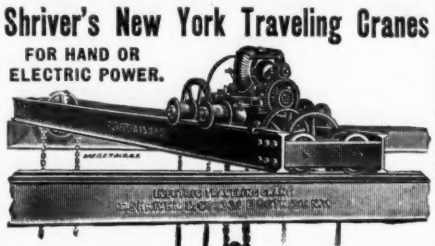

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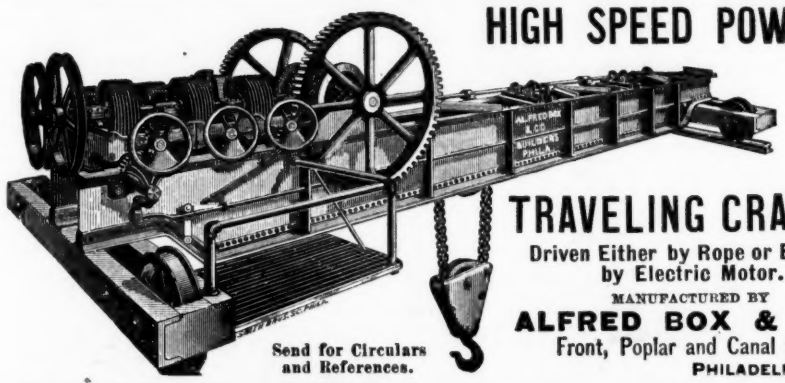

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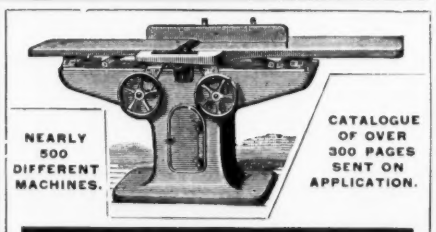

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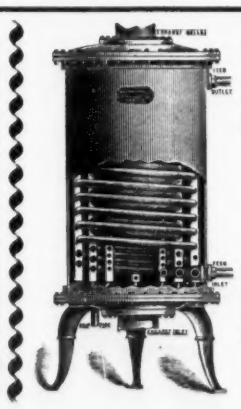

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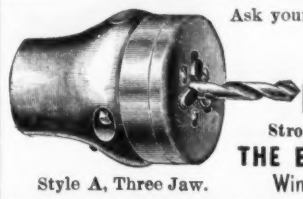

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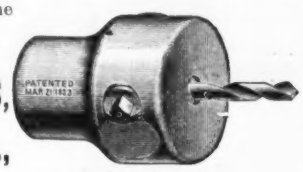

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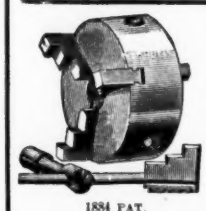

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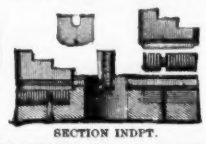

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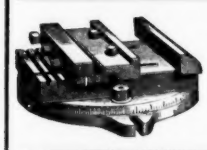

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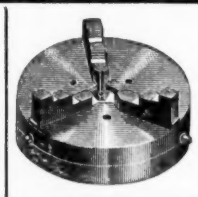

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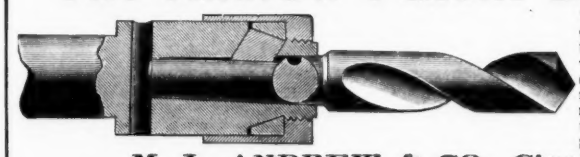

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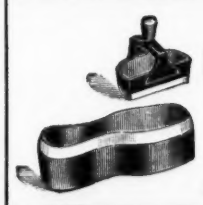

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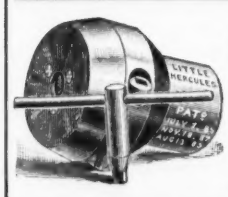

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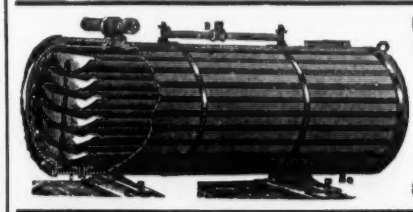

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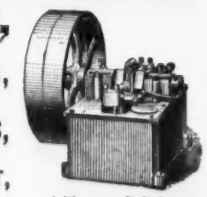

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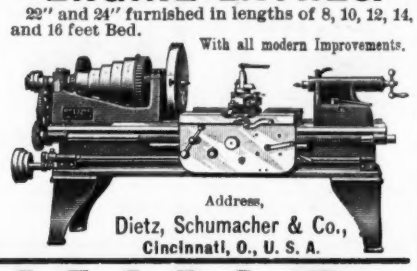

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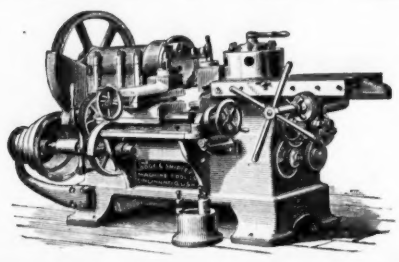

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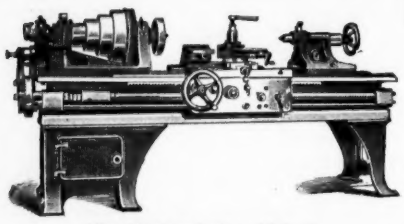

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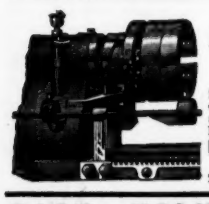

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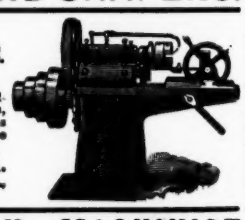

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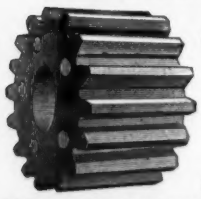

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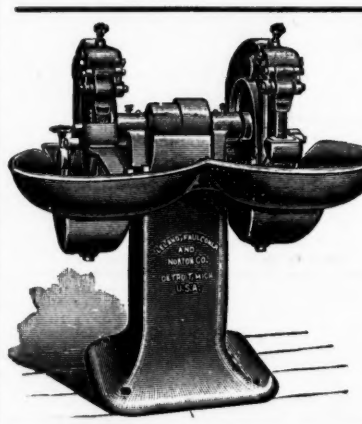

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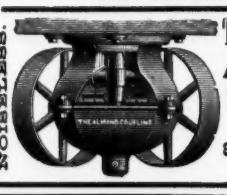

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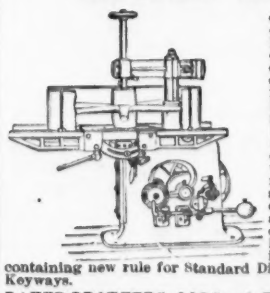

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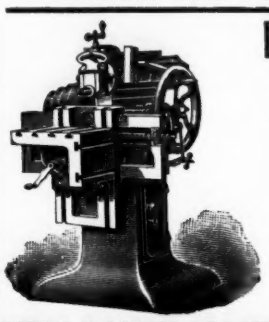

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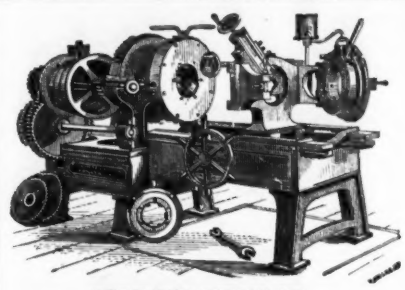

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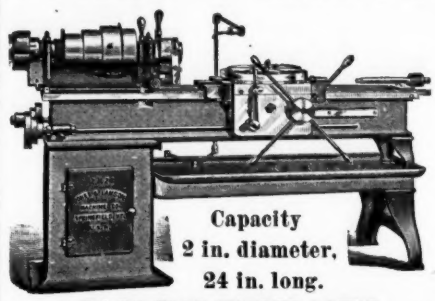

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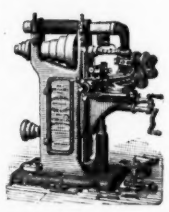

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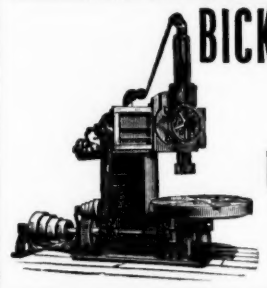

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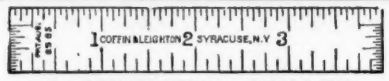

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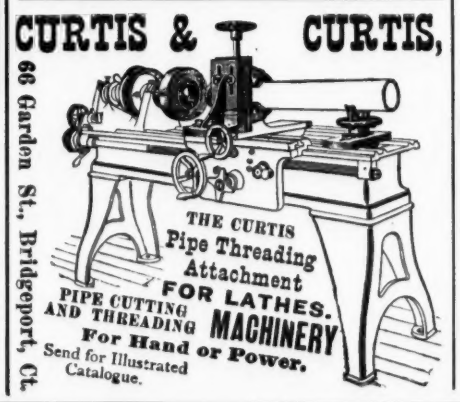

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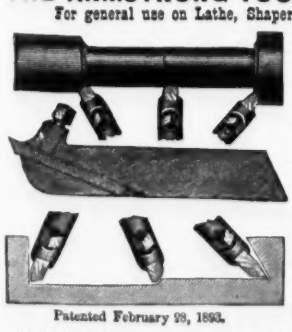

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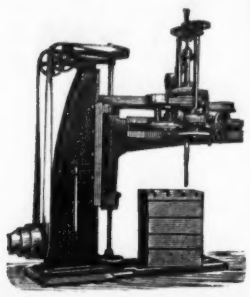

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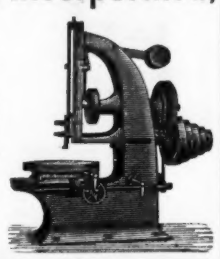

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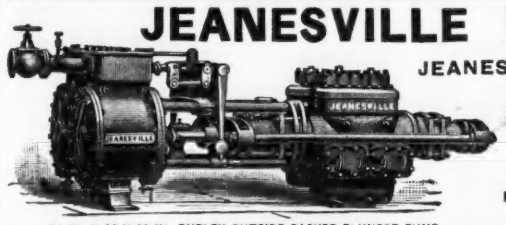

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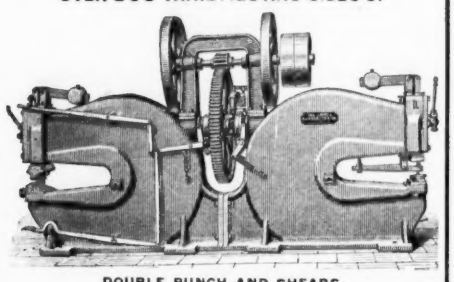
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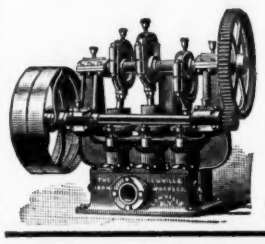
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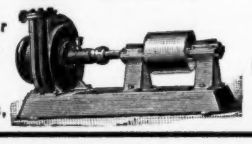
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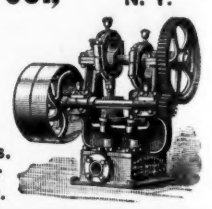

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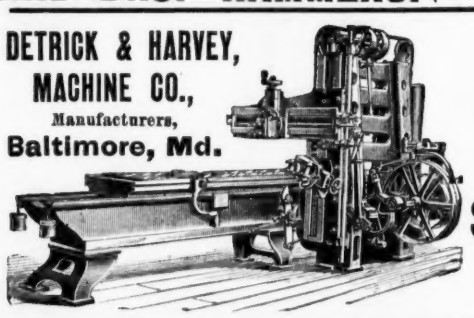

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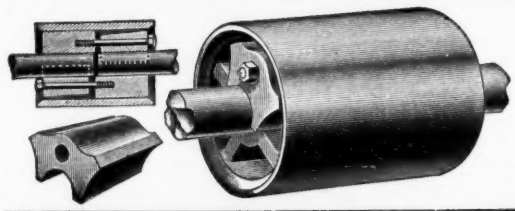

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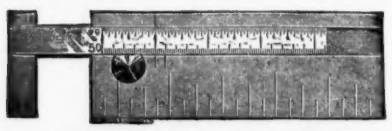

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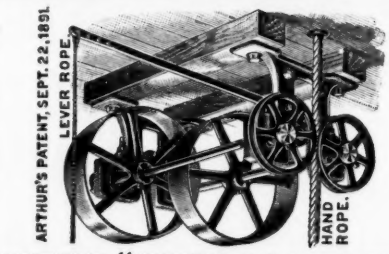

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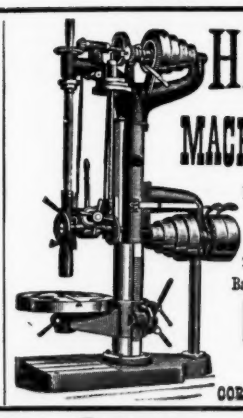

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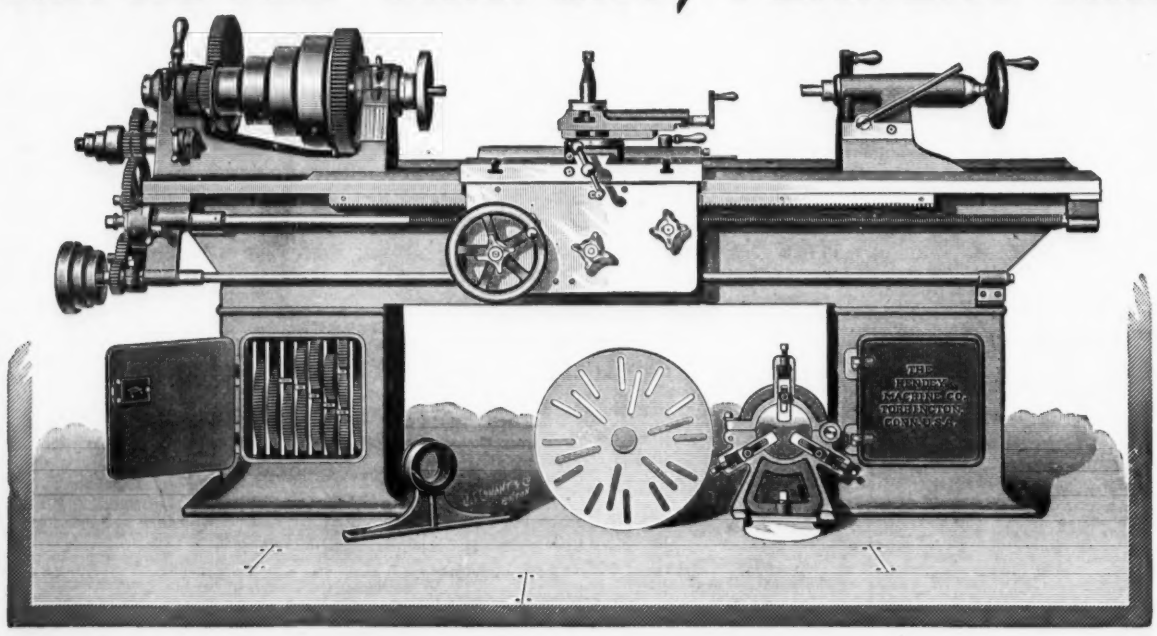

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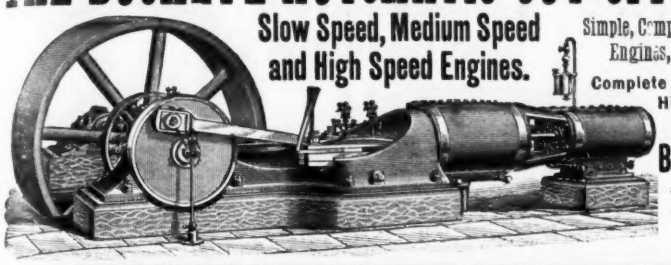

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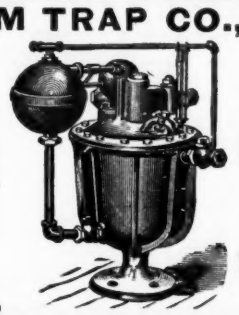

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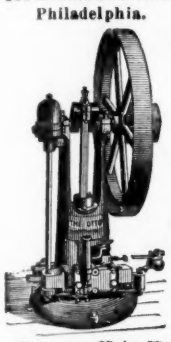

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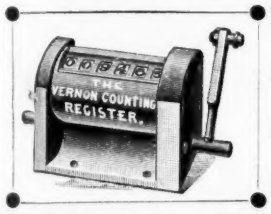

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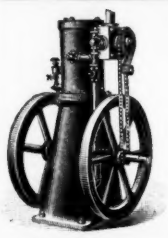

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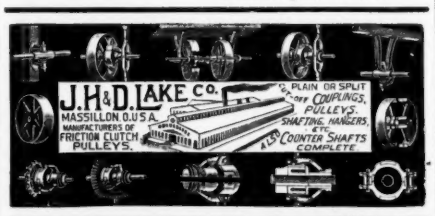

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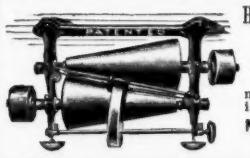

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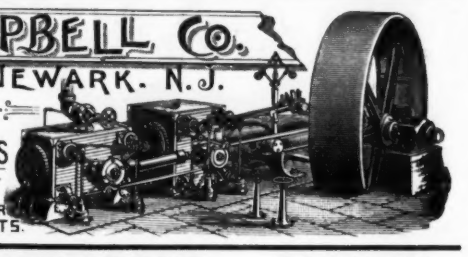

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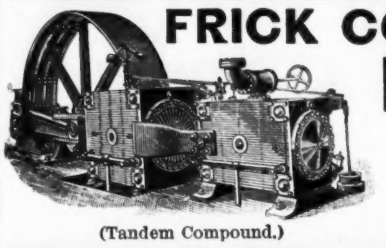

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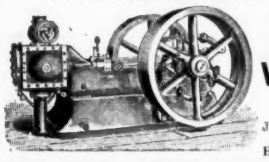

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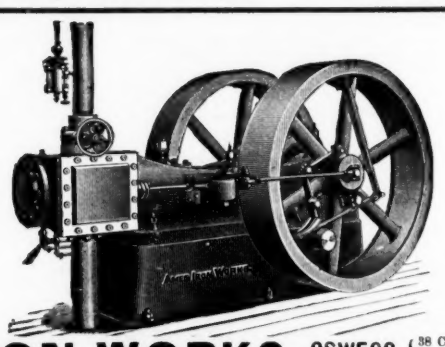

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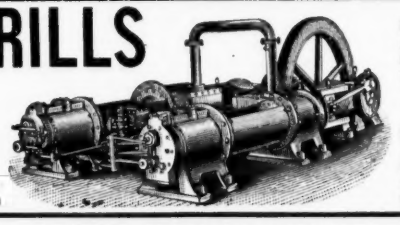

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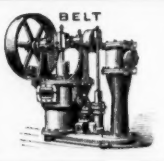

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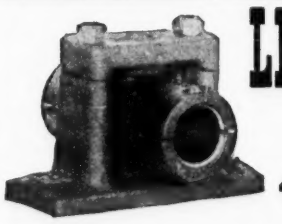

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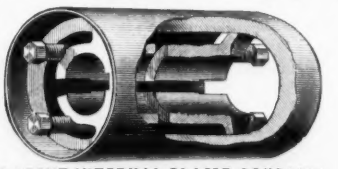

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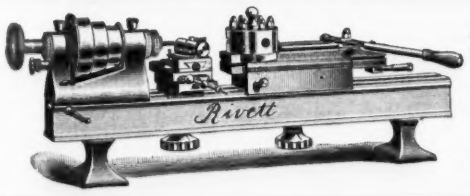

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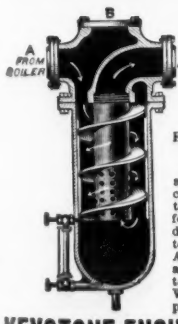

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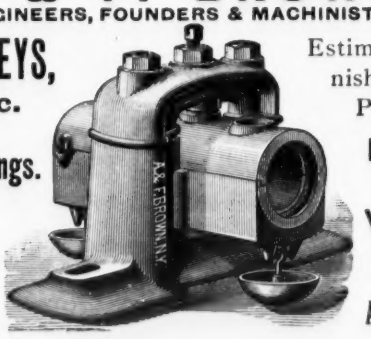

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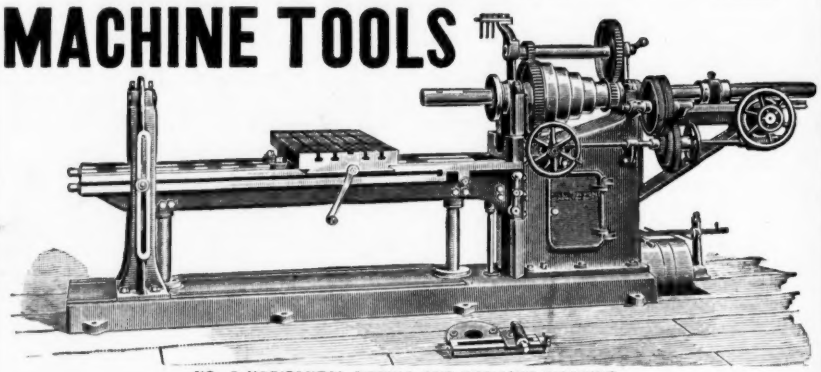

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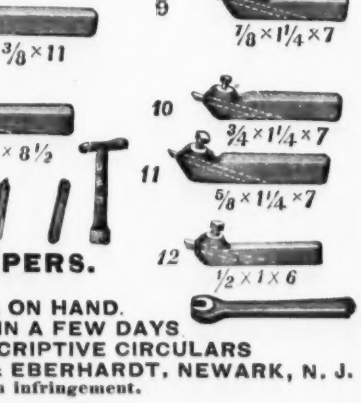

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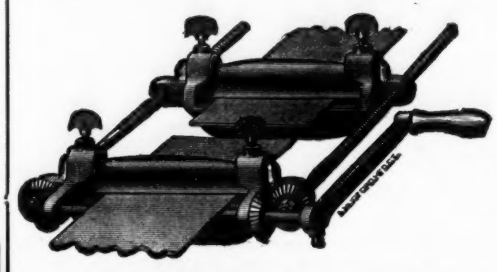

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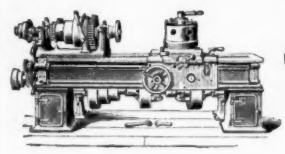

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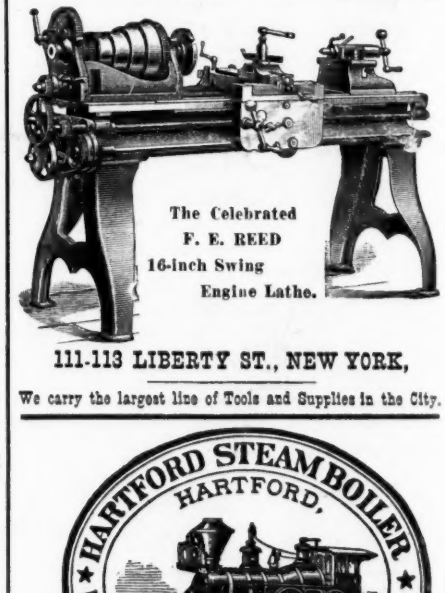

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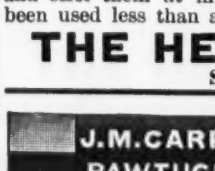

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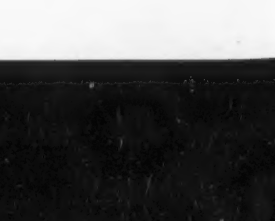

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